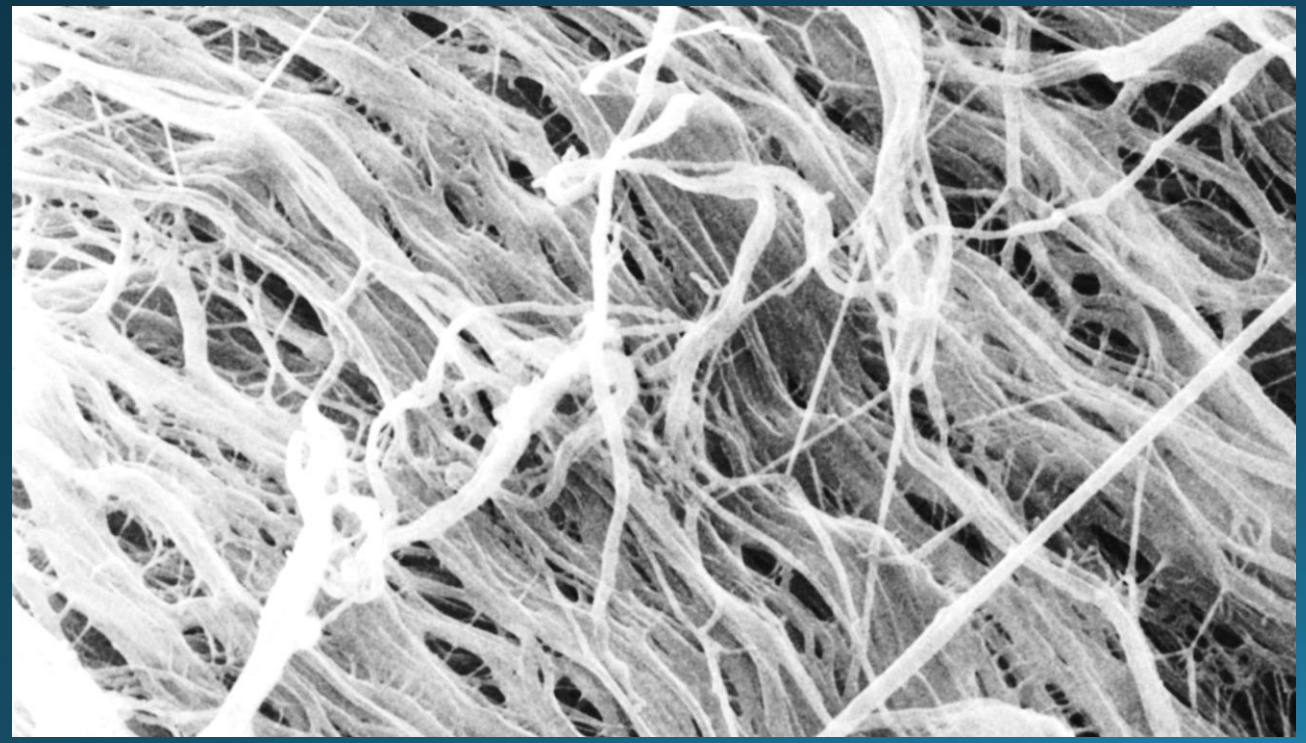
KCL BIOHUB webinar – Refining of biomass

Utilization of ATREX in biomass treatment

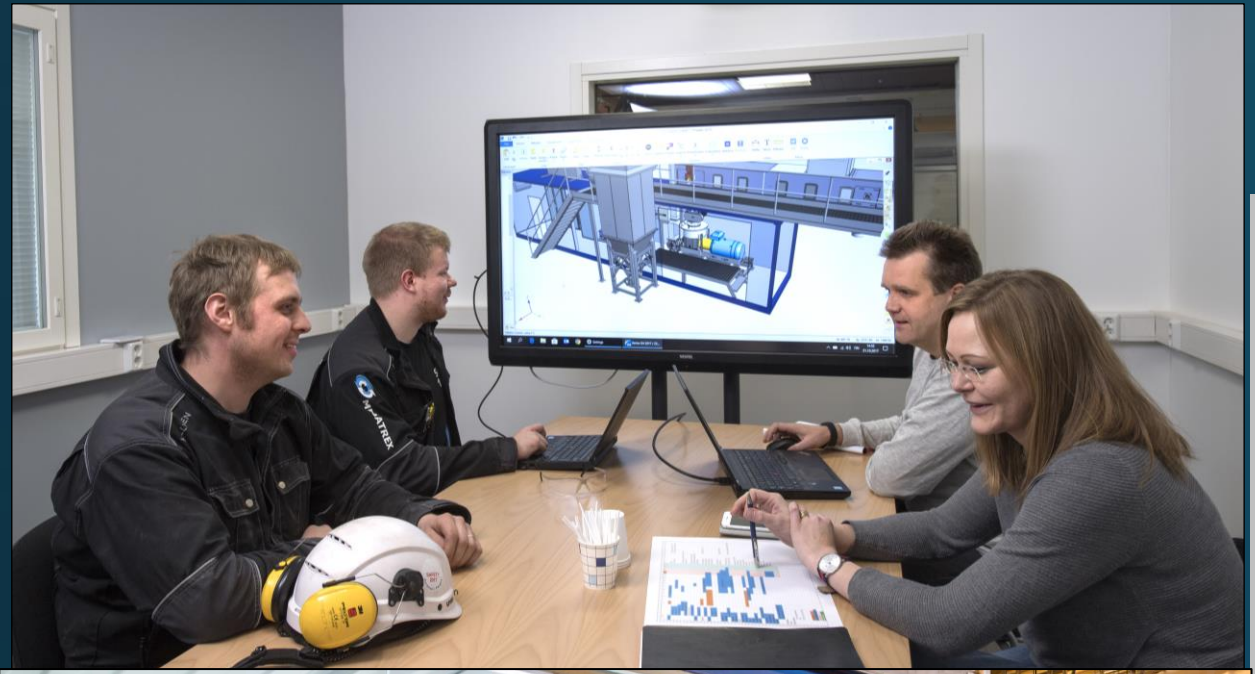


5.6.2024

Elias Retulainen

Content

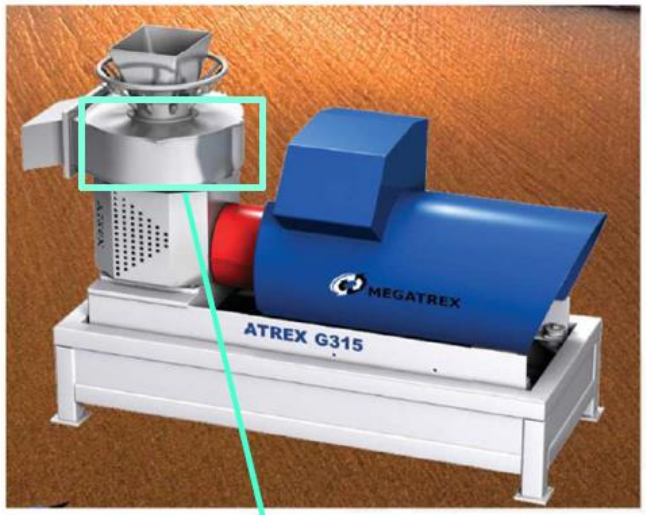
- Megatrex Oy
- What is Atrex?
- "Conventional" applications of Atrex
- Examples related to Biorefining and refining
- About mechanisms in Atrex
- Development vision

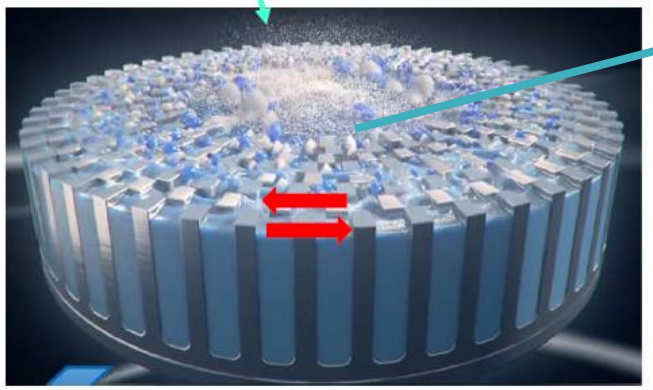


MEGATREX OY

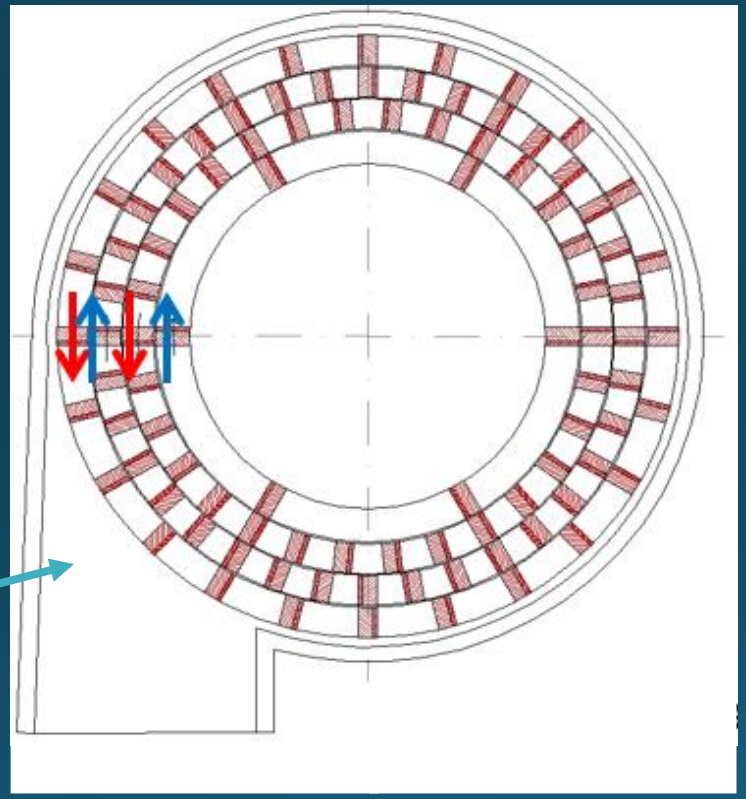
- A growth-seeking SME technology company
- ATREX equipment and technology, since 1995
- More than 400 references around the world
- Megatrex Oy's office and engineering works are located in Lempäälä, next to Tampere, Finland

Atrex – rotor-rotor principle

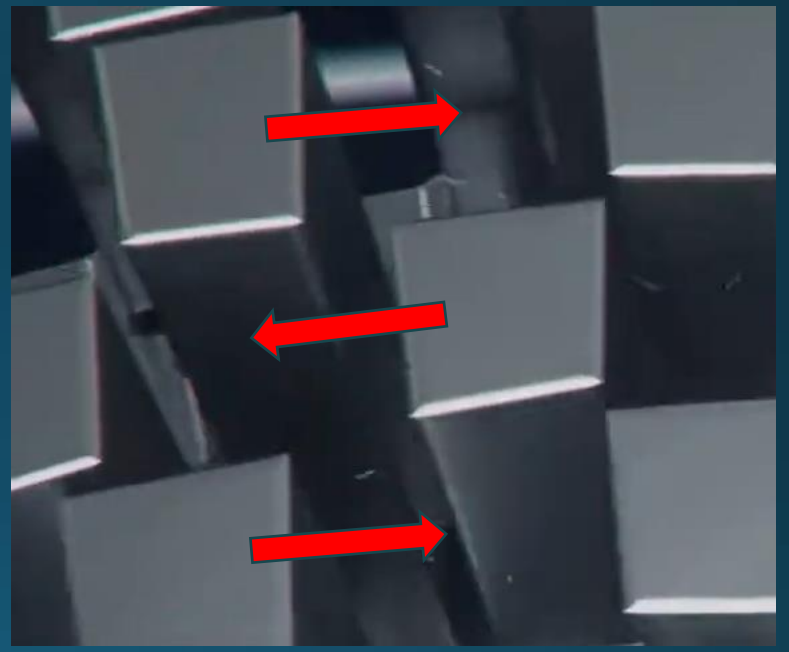




Counter rotating impact bars with speed up to 100 m/s



From 2 up to 8 rotors
Flow range 50-1000 L/min
Electric motors 30-700kWh



Numerous impacts
High shear forces and velocity differences
Strong pressure pulses
Extensive turbulence
Cavitational implotions?

Atrex –video: https://megatrex.com/en/products/

Dispersing of pigments

***Case 1*: Dispersing of most demanding pigment**

⇨ **COATING TALC**

Problems with conventional batch process:

- Difficulties in dispersing the talc to sufficient high solid, over 60 %
- Long batch time > difficult to reach capacity over 10 t/h
- Screening and pumping problems

MAIN RESULTS ACHIEVED WITH HIGH SHEAR MIXER

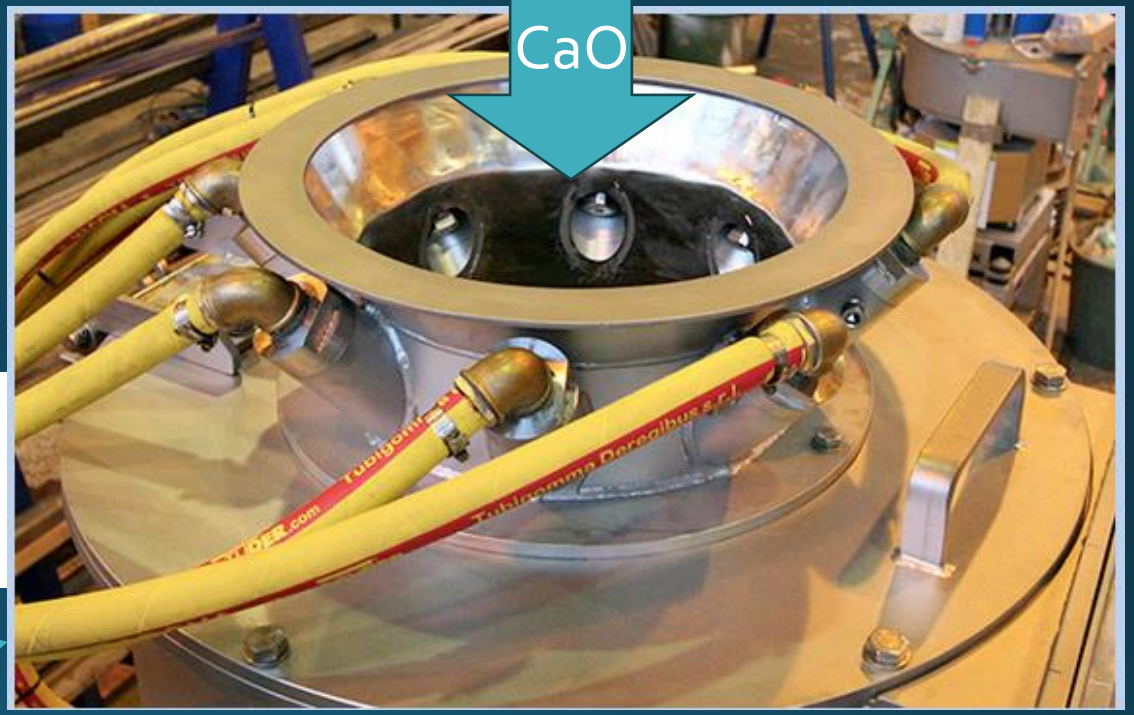
- High solid up to 67 % for coating talc slurry
- Capacity up to 20 t/h dry talc powder
- Continuous process
- Energy saving 40 – 50 %
- Improved rheology of the slurry > easier pumping and screening

Also the problems with rotor wear were solved

Example of Atrex used as reactor/disperser

- Slaking of quicklime:

$$CaO\ (s) + H_2O\ (l) \rightarrow Ca(OH)_2\ (s+l) + heat$$



Rather big lumps (~5 cm) are simultaneously crushed, ground and wetted and the violent reaction is performed safely in a closed process directly to nanosized products

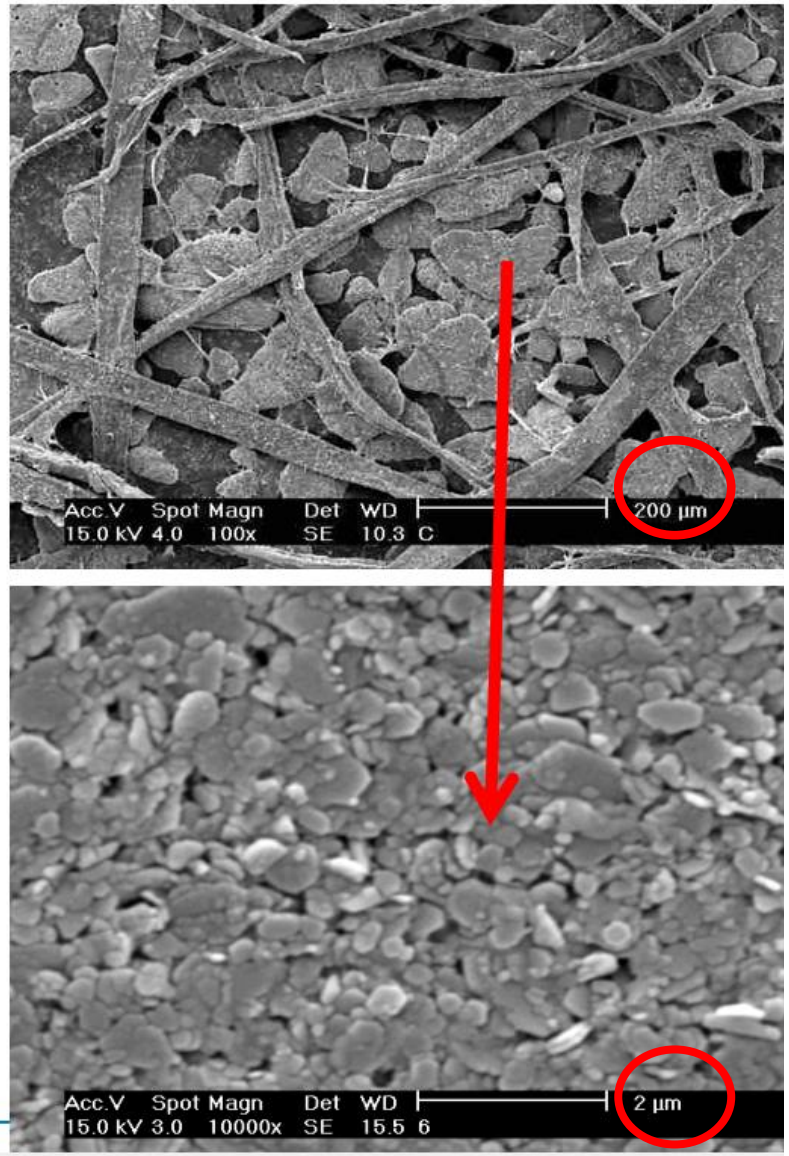
Dramatic enhancement of the slaking process

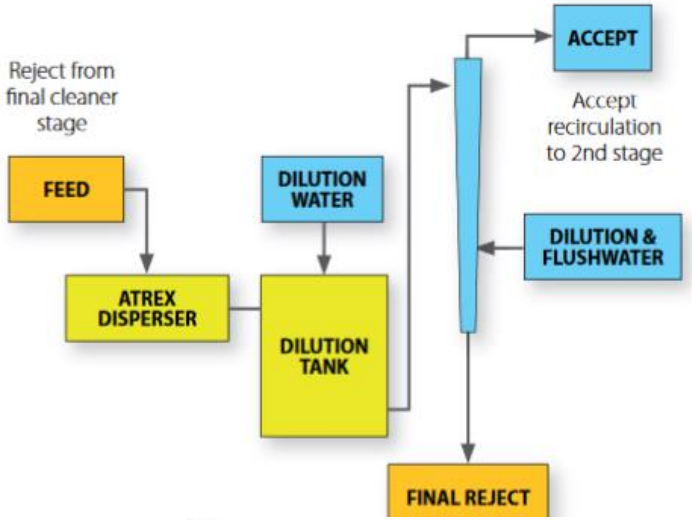
Reject treatment and recovery

CLEANER REJECT

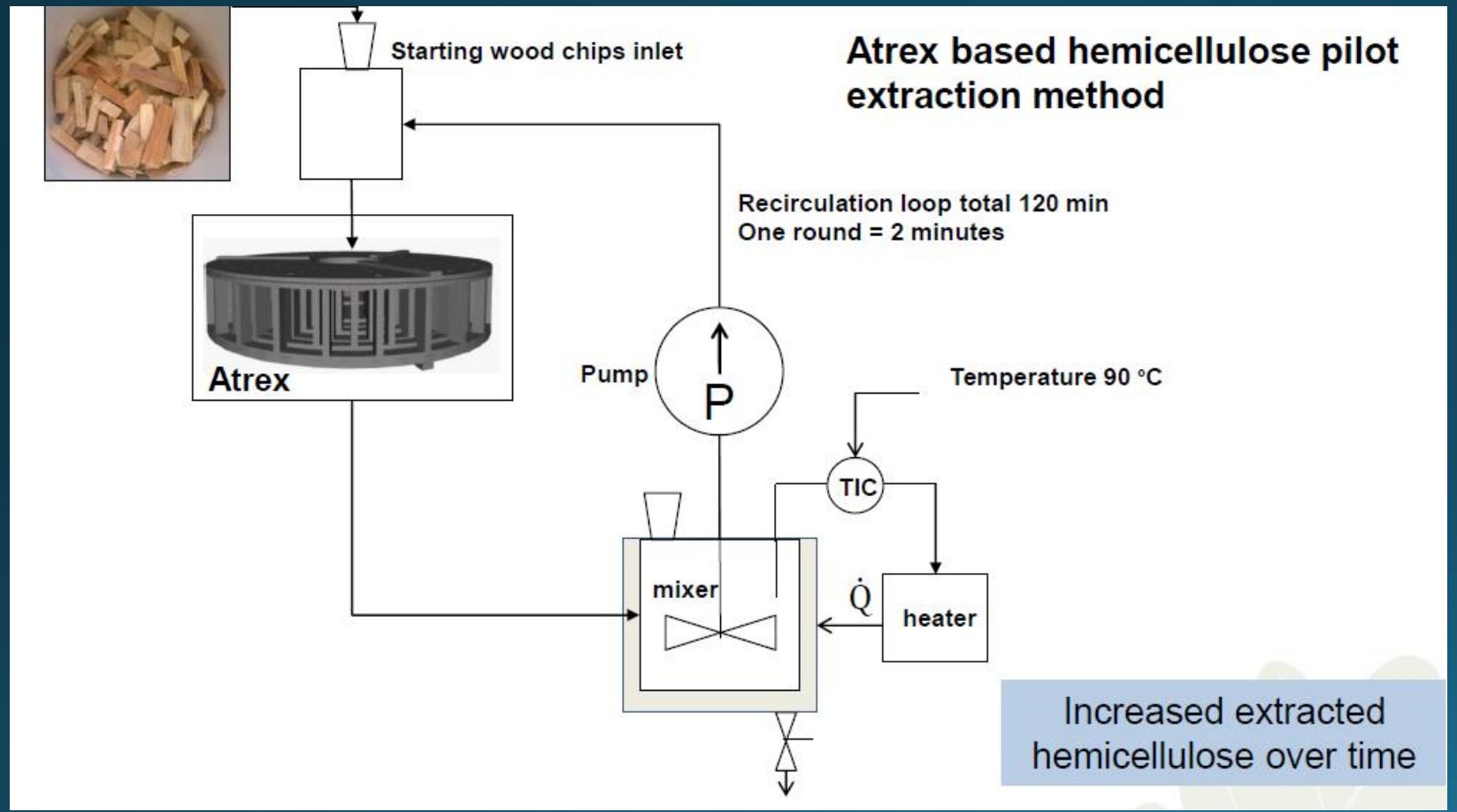
- Amount from 1 up to even 4% of the total tonnage of the paper or board production line
- Many cases hauled to the landfill
- Contains impurities but also valuable raw materials like minerals and fibers
- Especially the paper mills producing coated grades have a lot of coating flakes in their current reject streams ⇒ difficult deflaking

Also pigment recovery from coating effluent





Hot water extraction of hemicellulose from spruce chips



Yield 5x higher than in a conventional extraction process at 90 °C

A New Superior Mixer-Activator for Enhancing Chemical and Physical Processes

Pasi Tolvanen[1],Carl-Olof Palm[2] ,
Henrik Grenman[1], Tapio Salmi[1]

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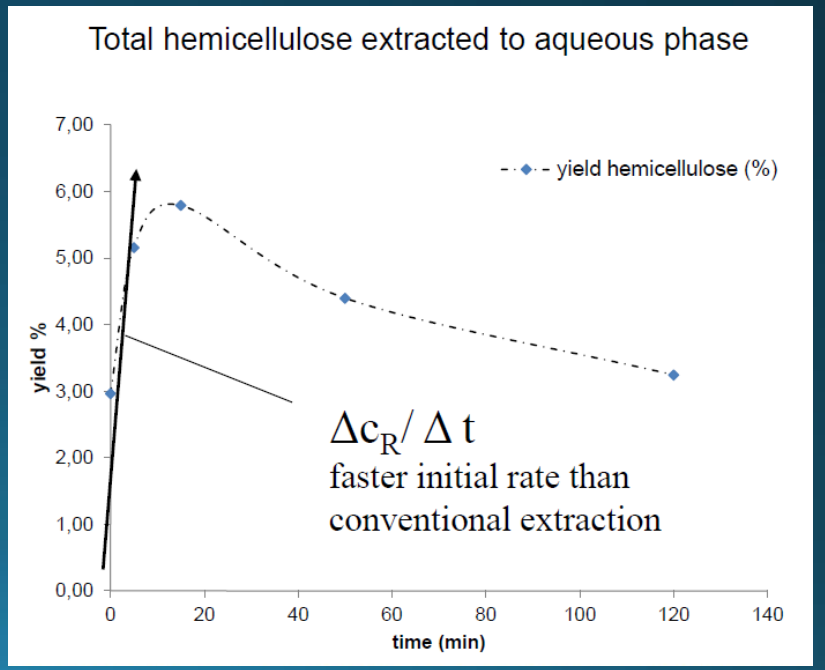
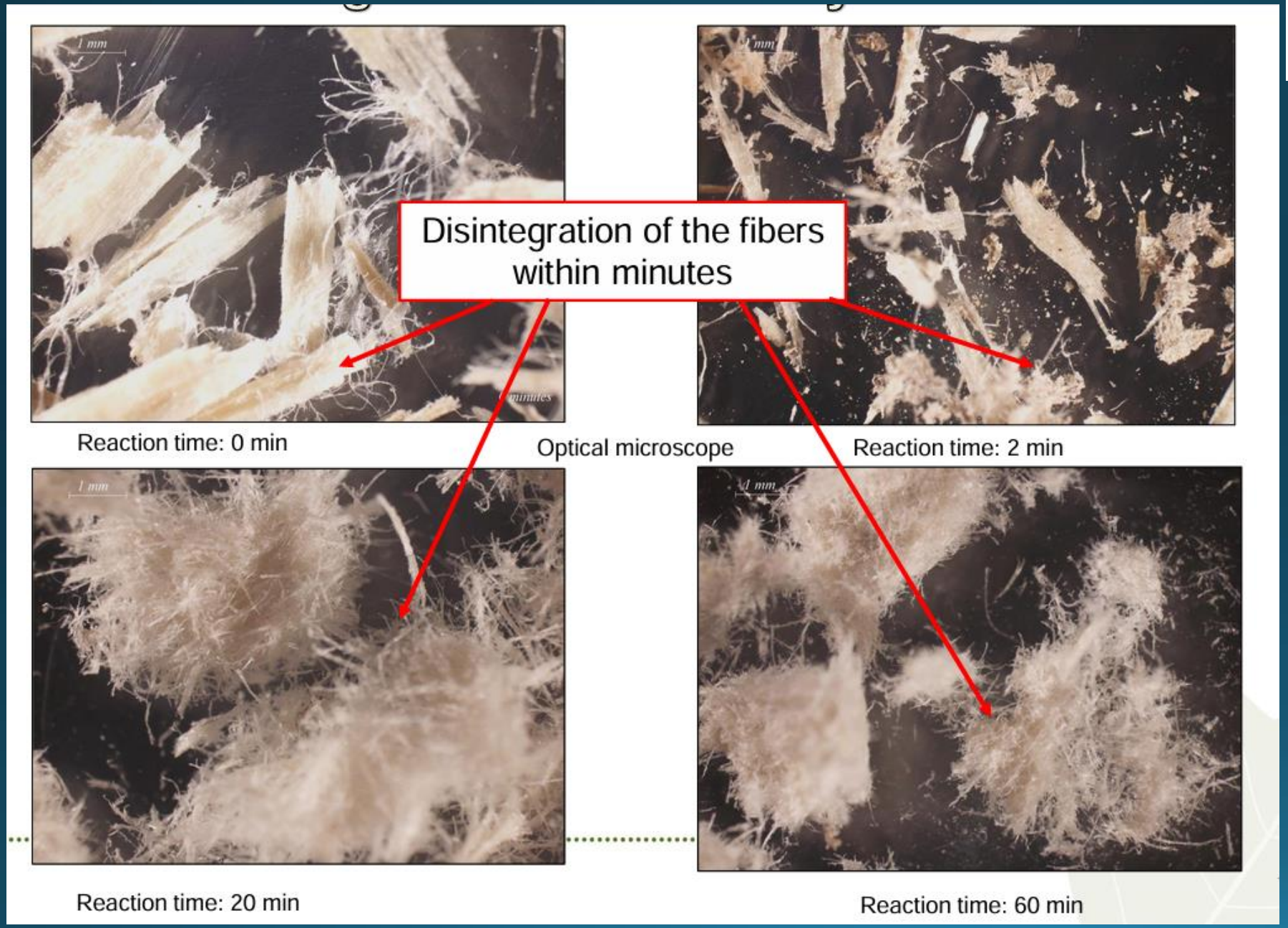
2 Megatrex Oy, Lempäälä, Finland





- New surfaces were opened for the extraction, when fibers were simultaneously disintegrated

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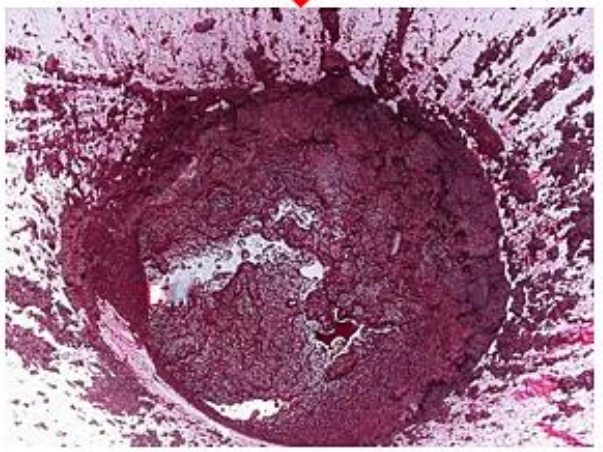
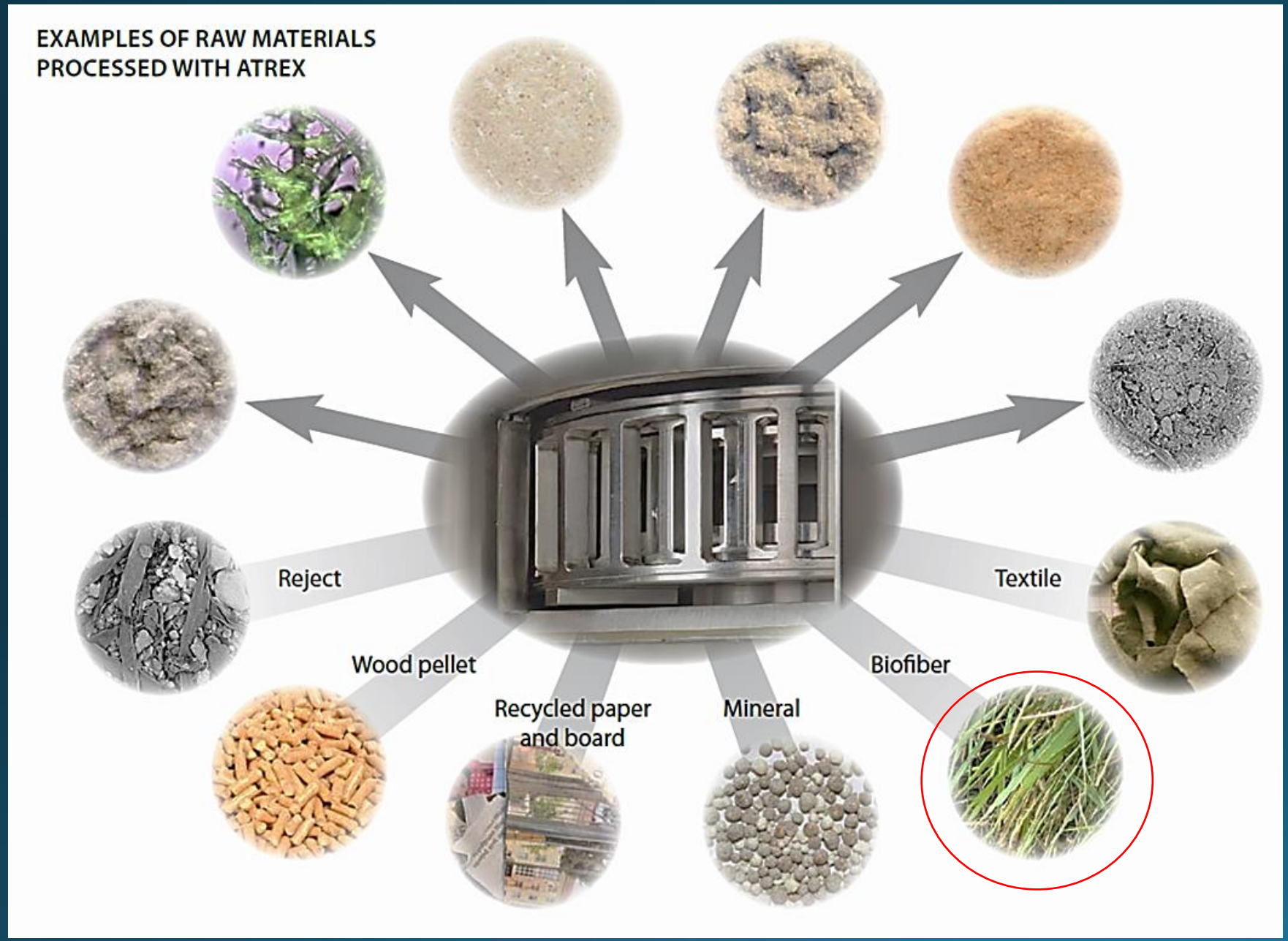
GRINDING OF GRASS

CRUSHING OF MILK CARTON

CRUSHING OF RED BEET



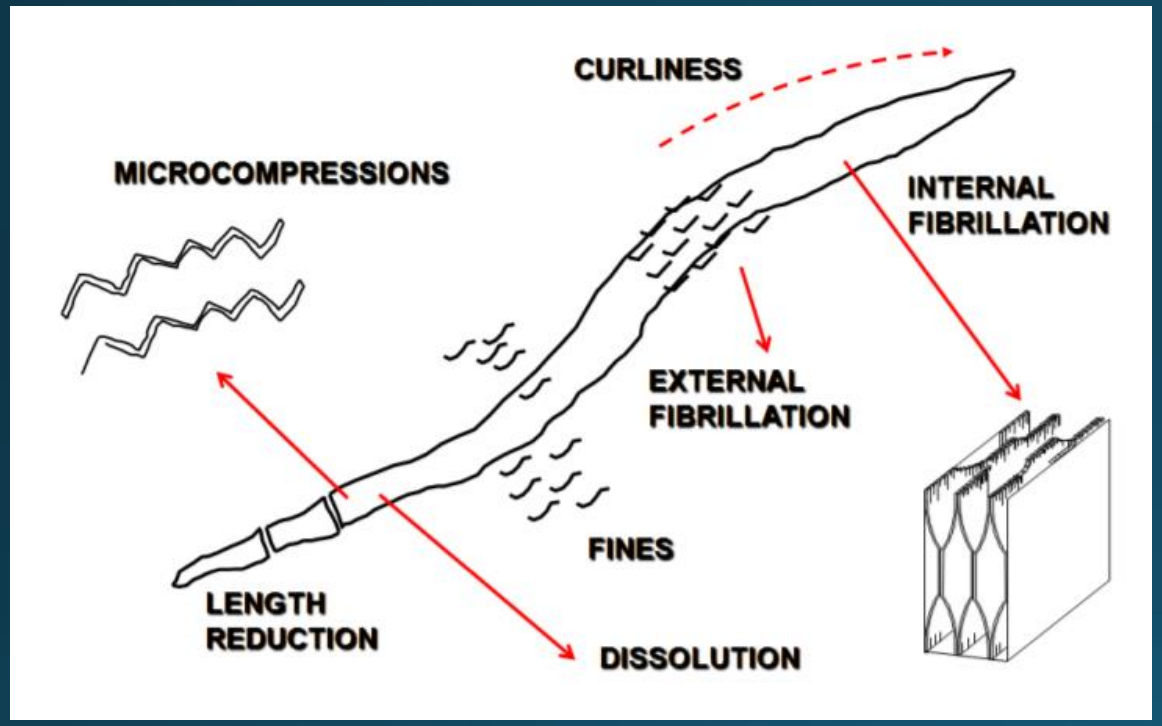


MEGATREX

- Atrex principle works with a wide variety of materials.
- Optimum conditions need to be found for each material

- Although cellulose is the most common natural polymer there is not enough cellulose to replace all the plastics, possibly only the increasing demand of the plastics.
- Therefore all cellulose sources, side streams, non-wood fibers need to utilised.

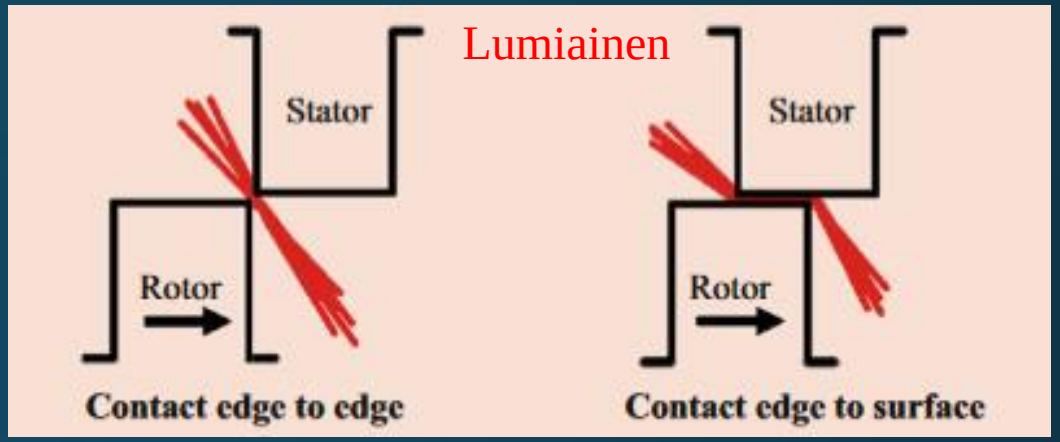
Phenomena in LC refiner

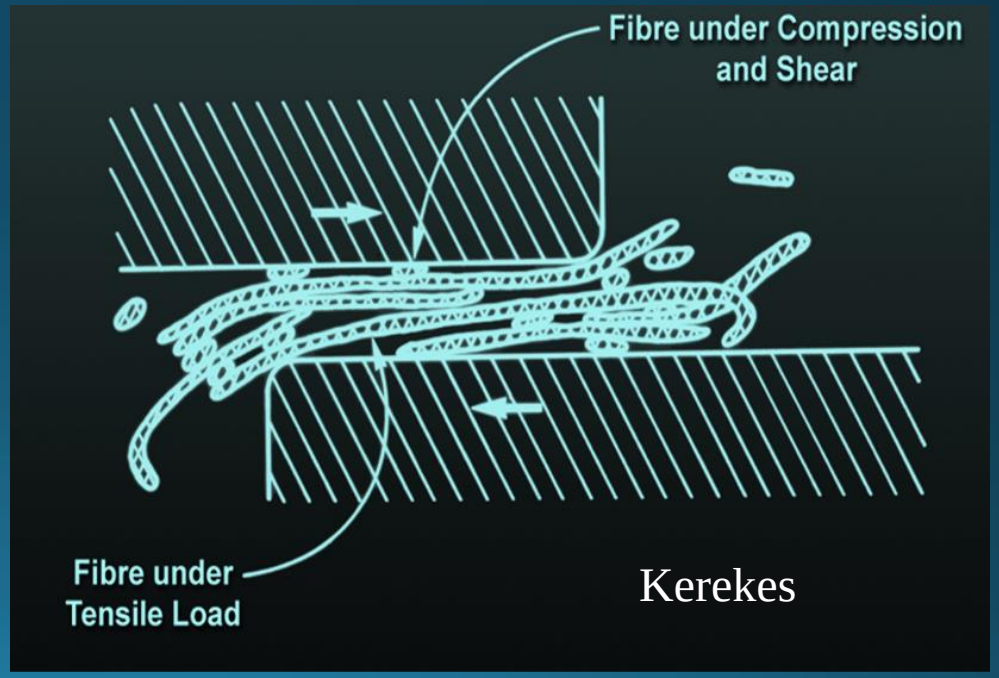


Kerekes

Basic effects of refining

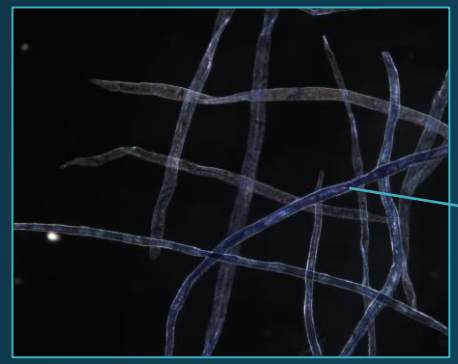
Fiber cutting is a most unwanted phenomenon, especially with short fiber pulps. Ultra-low specific edge load has been suggested.





Does this vision apply to Atrex?

What fibers experience in Atrex ?



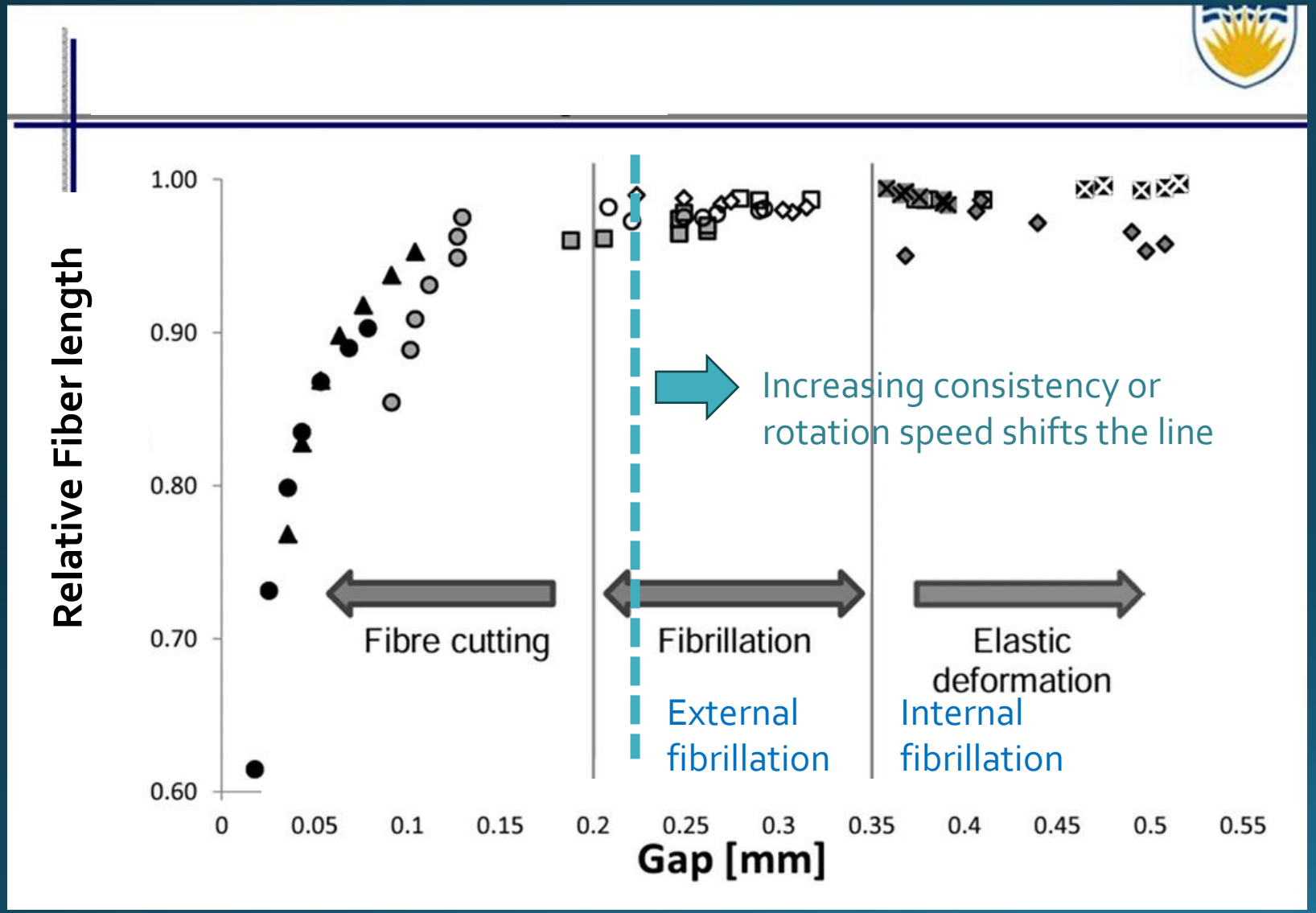
Softwood fiber 2 mm
Birch fiber 1 mm

Hypothesis:

Effects are more based on hydrodynamic shear, turbulence and pressure variations, than on direct contacts with the surfaces

Atrex functions like homogenizer or fluidizer

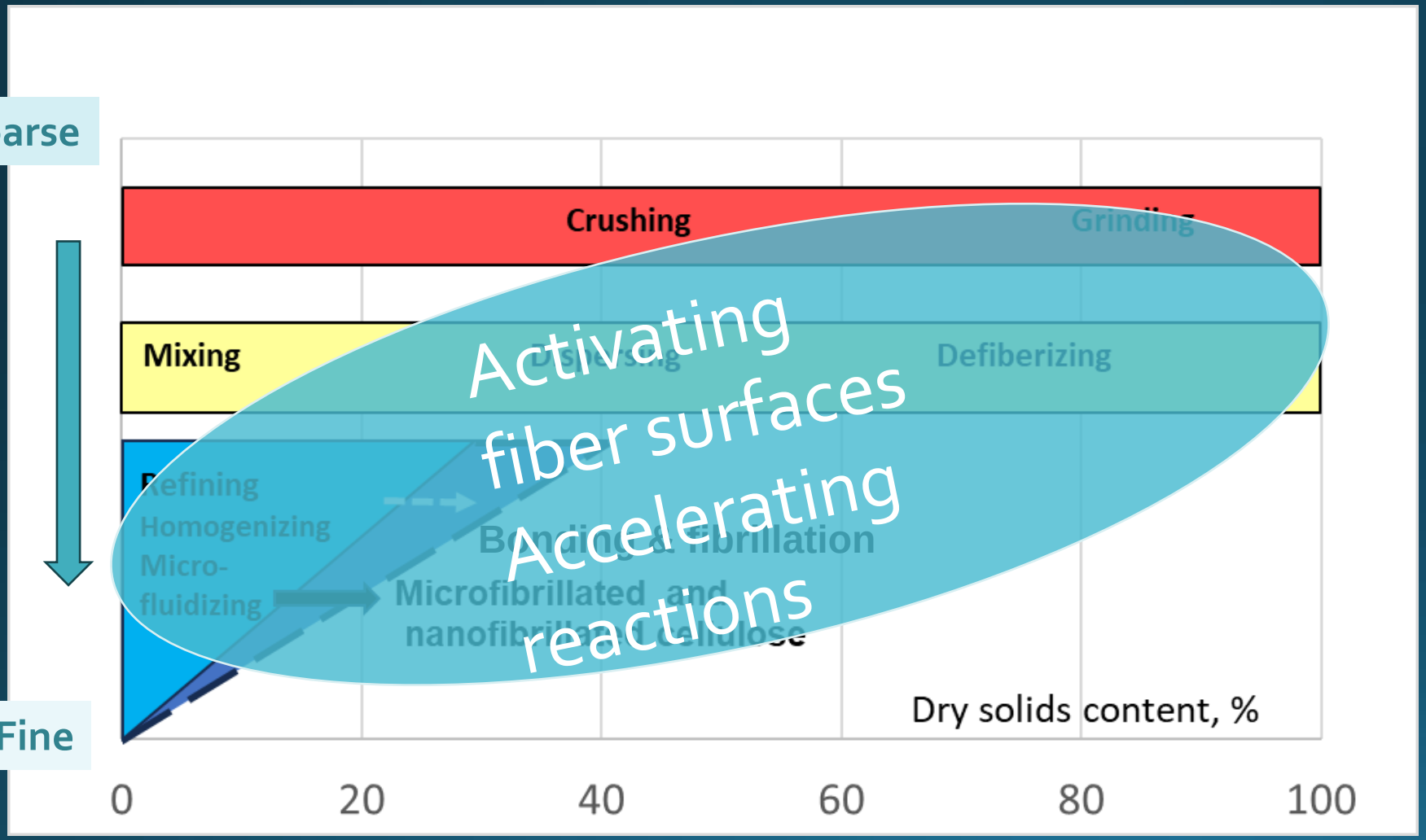
Fiber cutting vs. gap



- In LC suspensions Atrex is working outside the fiber cutting area
- Also "elastic" deformations cause H-bond breaking
- By increasing consistency or rotation speed the effects can be intensified

Modified from lecture of James Olson

Vision for future R&D



- Moving to production of finer, fibrillated cellulosic materials.
- Increase consistency, save water and energy
- Utilising the unique process principle for creating activated fiber surfaces

Thank you !

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