ENZYME SOLUTION FOR FIBER MODIFICATION - REFINING
Enzymatic modification of lignocellulose fiber has been explored for decades (e.g. bleach boosting, deinking, dewatering, etc.)

Multi-enzyme (multicomponent) products reduce refining energy effectively yet often at the expense of other properties.

Sensible application of a single enzyme from one of these products may provide partial or complete benefit with enhanced control.
Enzyme(s) can be applied to selectively modify the physical and/or chemical nature of the surface and superficial layers of papermaking fiber.

Application of enzyme can offer several benefits over conventional processes, including reduced refining energy, increased paper strength, etc.
MECHANISM OF ENHANCED REFINING WITH FIBERCARE

- The mechanism of enzymatically-enhanced refining remains somewhat speculative
- Expected to vary as a function of substrate, enzyme, conditions & equipment
- FiberCare activity at accessible fiber surfaces influences:
  - Surface fibrillation/defibrillation
  - Hydration & charge of fiber wall
  - Adhesion between wall layers
  - Mechanical integrity of deformations
  - Floc structure and size
- Most likely, a specific combination of these “events” alter the response of the whole pulp to refining
Papermaking properties of fiber can be developed with less refining
- Energy savings
- Increased refiner capacity/throughput = increased productivity

Improved papermaking properties can be obtained at the current/lower level of refining to obtain:
- Increased value of the final product
- Reduced use of wet/dry strength additives
- Increase in paper ash content
Enzymes “strengthen” paper by increasing the number, area, and strength of interfiber bonds

Bleached Softwood: FiberCare R
ENZYMATIC REFINING IN THE MILL (CASE 1)

- Paper grade: 47 g/m² NCR paper (on-line coating)
- Machine speed: 830 m/min
- Furnish: 10-12% BSWK, 88-90% BHWK
- Enzyme treated pulp: BSWK (100 g/t)
- Dosing point conditions:
  - Temperature 40-45°C
  - pH = 5.6-6.5
- Saved ~107 kWh/t dry pulp
  - ~36.15% refining energy reduction
- “Filler” increased from 50 to 65 kg/t
ENZYMATIC REFINING IN THE MILL
(CASE 2)

- Paper grade: 120 g/m² offset
- Machine speed: 150 m/min
- Furnish: 30% BSWK, 25% BHWK, 45% wheat straw
- Enzyme treated pulp: BSWK (110 g/t)
- Dosing point conditions:
  - Temperature 20-30°C
  - pH = 7.5 - 8
- Saved 132 kWh/t refining energy
  - Reduced 49% refining energy
- Increased 9% breaking length
- Increased 4.2% tear strength
SUMMARY

- Multicomponent cellulase applications readily improve the *beatability* of bleached kraft pulp.
- A monocomponent cellulase, e.g. FiberCare provides the same benefit with a greater degree of control.
- During a full-scale trial, FiberCare application resulted in up to 49% refining energy reduction.
- Additional benefits include: improved machine speed, filler retention, formation & performance.
- *Important to note that beneficial enzyme application requires practical expertise with enzyme formulation, stock preparation, wet-end chemistries, machine operation and targeted specifications.*
APPLICATION:

- **Product:** Fibercare
- **Dosage:** 50 – 250 g/t
- **Temperature:** 30 - 70°C
- **pH:** 6 – 8
- **Treatment Time:** minimum 30 minutes and preferably more than 60 minutes
- **Type of pulp:** Bleached Hardwood Kraft (LBKP)/ Bleached Softwood Kraft (NBKP) / Unbleached Kraft (UBKP)
- **Dosing Point:** Before Refiner
THANK YOU