p a p e r m o r p h o s i s®

h i g h l y e n g i n e e r e d p a p e r

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Fifth Annual
RISI China International Recycled Fiber Conference
December 8-9, 2016 | Zhuhai, China

Innovative technologies for improving recycling papers and invading new application segments

what could papermakers want from innovative technologies?

- ✓paper with better mechanical properties at unvaried production cost?
- ✓standard paper at lower production cost?
- ✓new market segments for paper?

"innovation is the only way to win" (Steve Jobbs)

who we are

gruppo X di X gruppo srl, based in Venice/Italy is a company which

- ✓ generates patents on innovations in the paper sector,
- ✓ develops those patents with industrial partners, and
- ✓ licenses patents, know how and technology

where we started from

in the past we found the need of a cost saving and sustainable alternative to plastics or alu in 3D packaging.

we developped the "Mould Paper- Technology": a purely mechanical treatment with no particular chemical additives for the production of a paper with over 20% stretch in Machine Direction and up to 16% stretch in Cross Direction, combined to a high strength deriving from virgin fiber and high refining.

market presence today

paper cans

Mould Paper and its applications has been licensed exclusively for Europe to **Billerudkorsnas AB**. The tradename is **FiberForm**

paper reels to be converted to:

3D packaging

new corrugates

drawbacks of today's stretch for paper

our previous technology was able to reach high stretch in both CD (16%) and MD (over 20%) but those values could not be tuned separately

traditionally available technologies for MD-elongation do work only in MD (about 15%), potential CD elongation derives from pure virgin pulp and costly high refining and does usually not exceed 8%, limiting such technologies to a total symmetric performance of 8% in each direction

no symmetry CD and MD over 8%

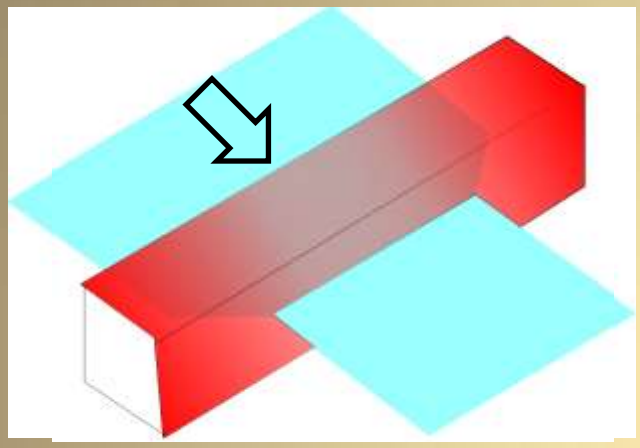
our new development

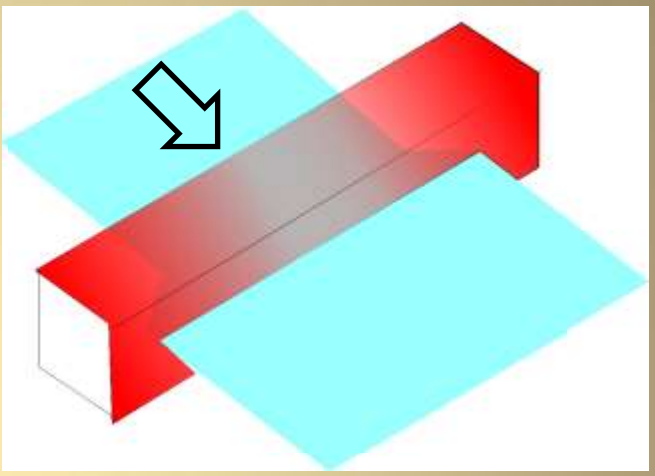
CROSS DIRECTION & MACHINE DIRECTION
tuning system: 2 units for customizing elongations
1 CD-unit – 1 MD-unit

the system allows to separately adjust stretch in **Cross** Direction and/or **Machine** Direction on demand.

the CD-UNIT

need of a system for separately adjusting CD-stretch

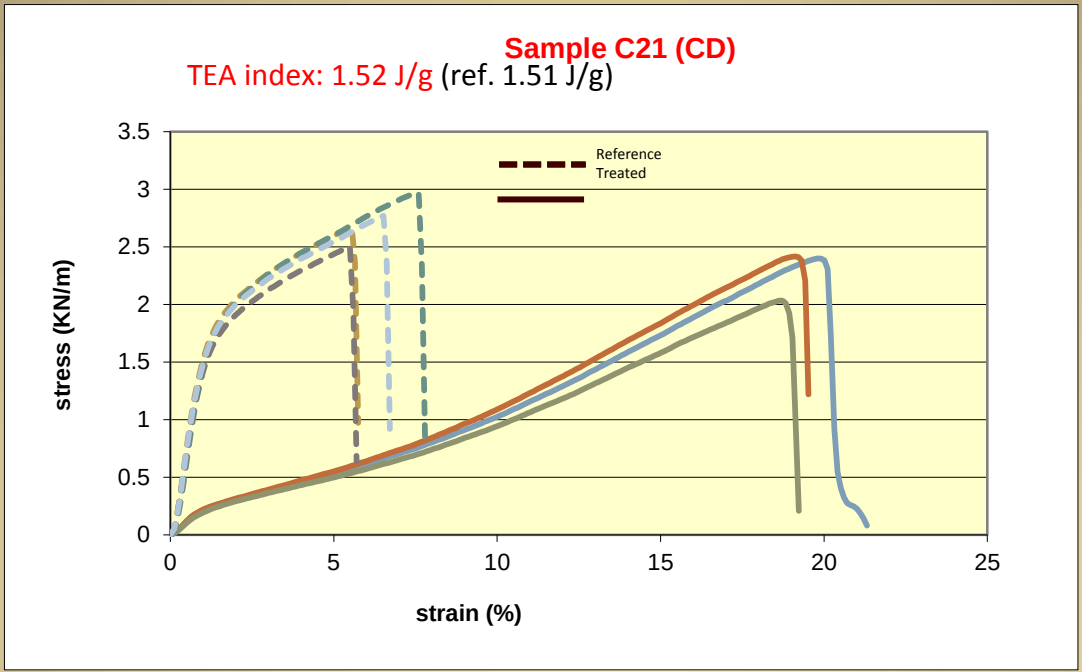




we can today impart up to 20% stretch to a fibrous web from standard values

viceversa, width in a fibrous web can be increased (up to 4%) compensating shrinkage due to drying for more trim width.

the next step



once having achieved the freedom to "add on" **CD**-stretch to what a paper already has (even just 2 or 3% in absolute terms) up to 20% we could combine this system for **CD**-elongation to systems of **MD**-elongation

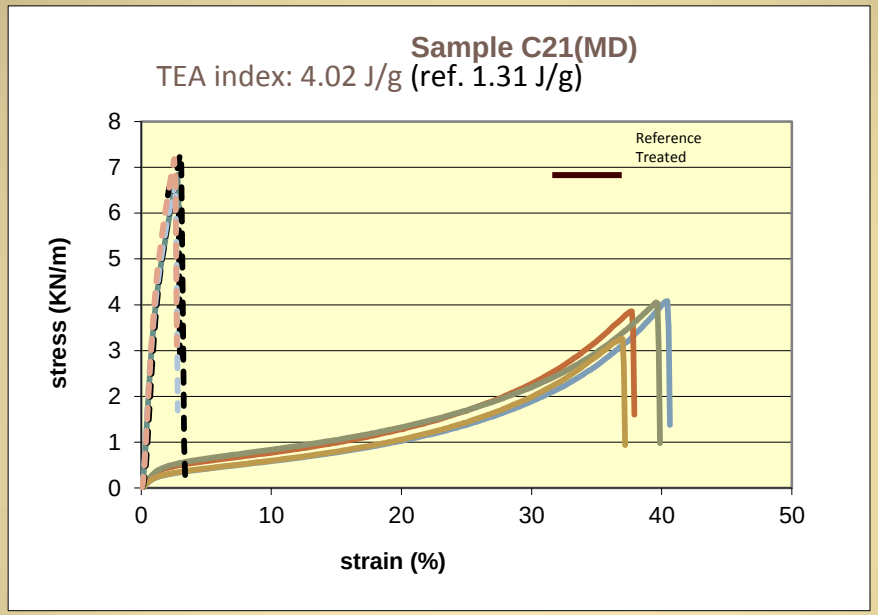
the MD-UNIT

for the combination to our CD-unit. we have developped a MD- unit, with many parameters for different settings for different product needs:

- ✓ adjustable nip size and paper contact area
- ✓ flexibility for desired stretch
- ✓ uniformity of treatment over whole width
- ✓ no need of lubrication

exasperating elongation in MD

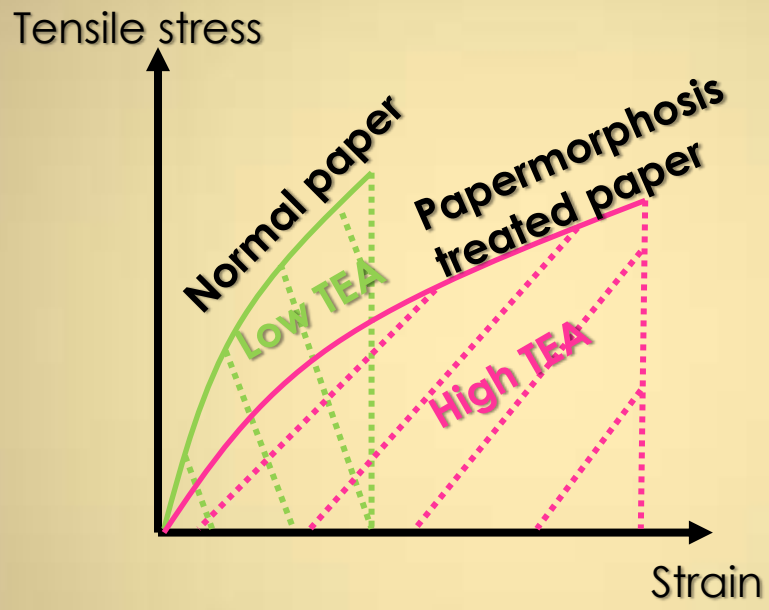
Having reached around 20% in CD-stretch we tried the maximum performance in MD-stretch



initially we wanted to do as much stretch as possible. Probably very few paper makers would have a standard market for material with 20% or more stretch in each direction.

more effects of tailored stretch

still by customizing **CD** and/or **MD** values separately, other mechanical properties can be influenced



TEA**CD** = TEA**MD** ?

Tensile energy absorption in **CD** and **MD**, maybe not symmetric but more balanced

why not trying with recycling paper?

from focused customer trials we saw that our system can meet many targets:

- ✓high symmetric stretch in **C**D and **M**D
- ✓improved TEA-values
- ✓focused joints of stretch/TEA where needed
- ✓standard-qualities with less refining costs
- ✓standard qualities with less furnish costs

more stretch/TEA for recycling paper?

The more stretch the later a paper breaks or cracks under stress

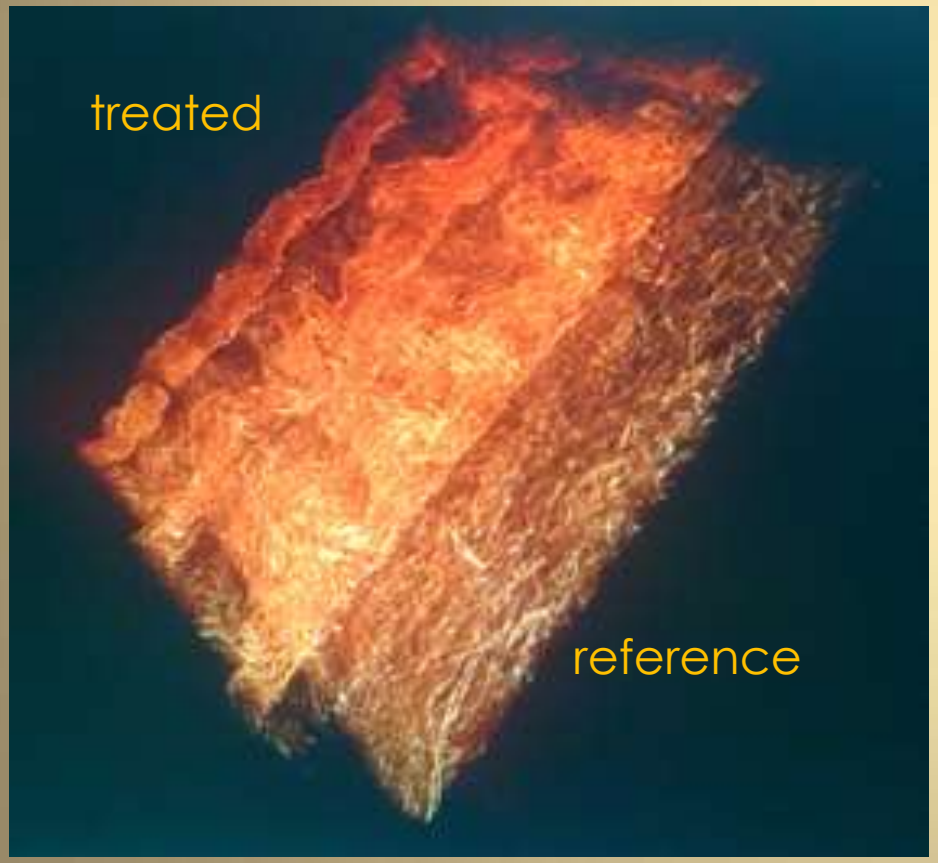
Increased stretch for folding

3D-packaging

Increased TEA for drop test, no negative impact on Gurley

increasing bulkiness and absorbency?

our processes can also contribute to fluffiness and bulkiness for paper and even non wovens



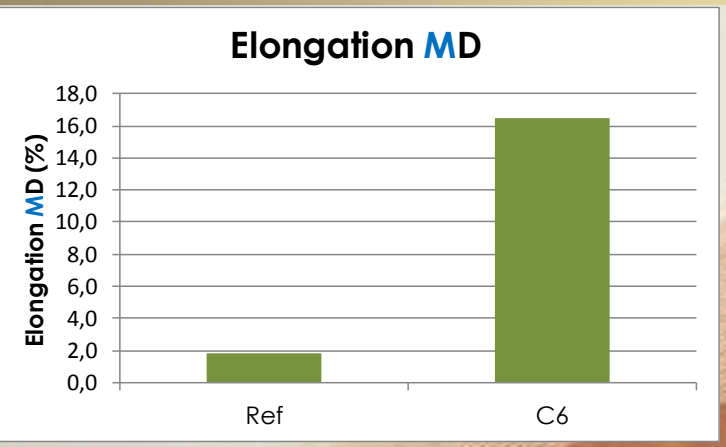
µXRay Computer Tomography on treated and reference material

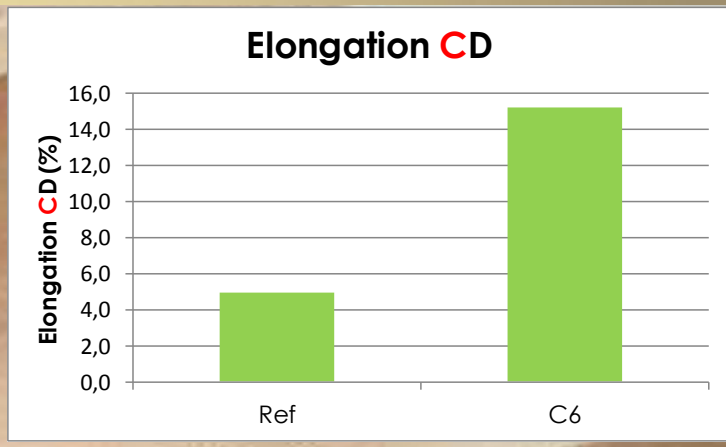
tissue, wipes etc

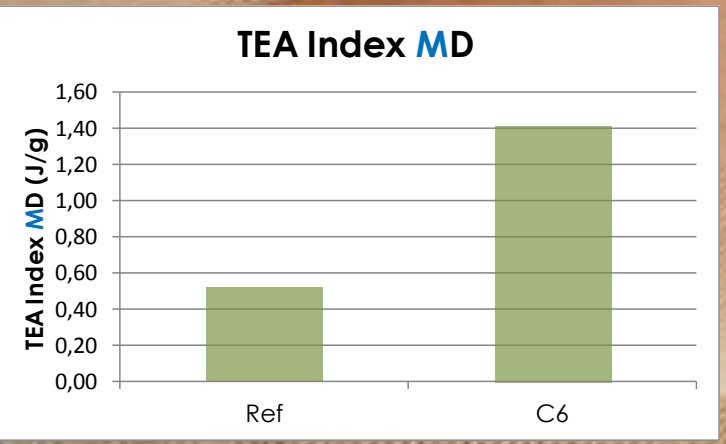
target 1: high symmetric stretch

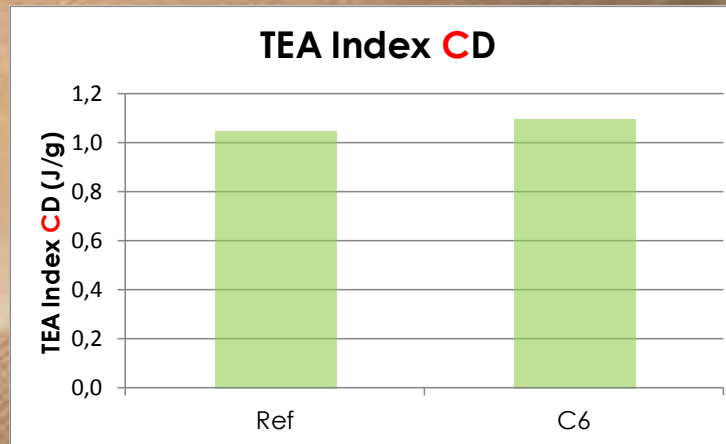
Used pulp: 30% unbleached kraft and 70% OCC, final 28° SR

Result on treatment with both UNITS: symmetric stretch of around 15% in CD and MD, increased TEA values





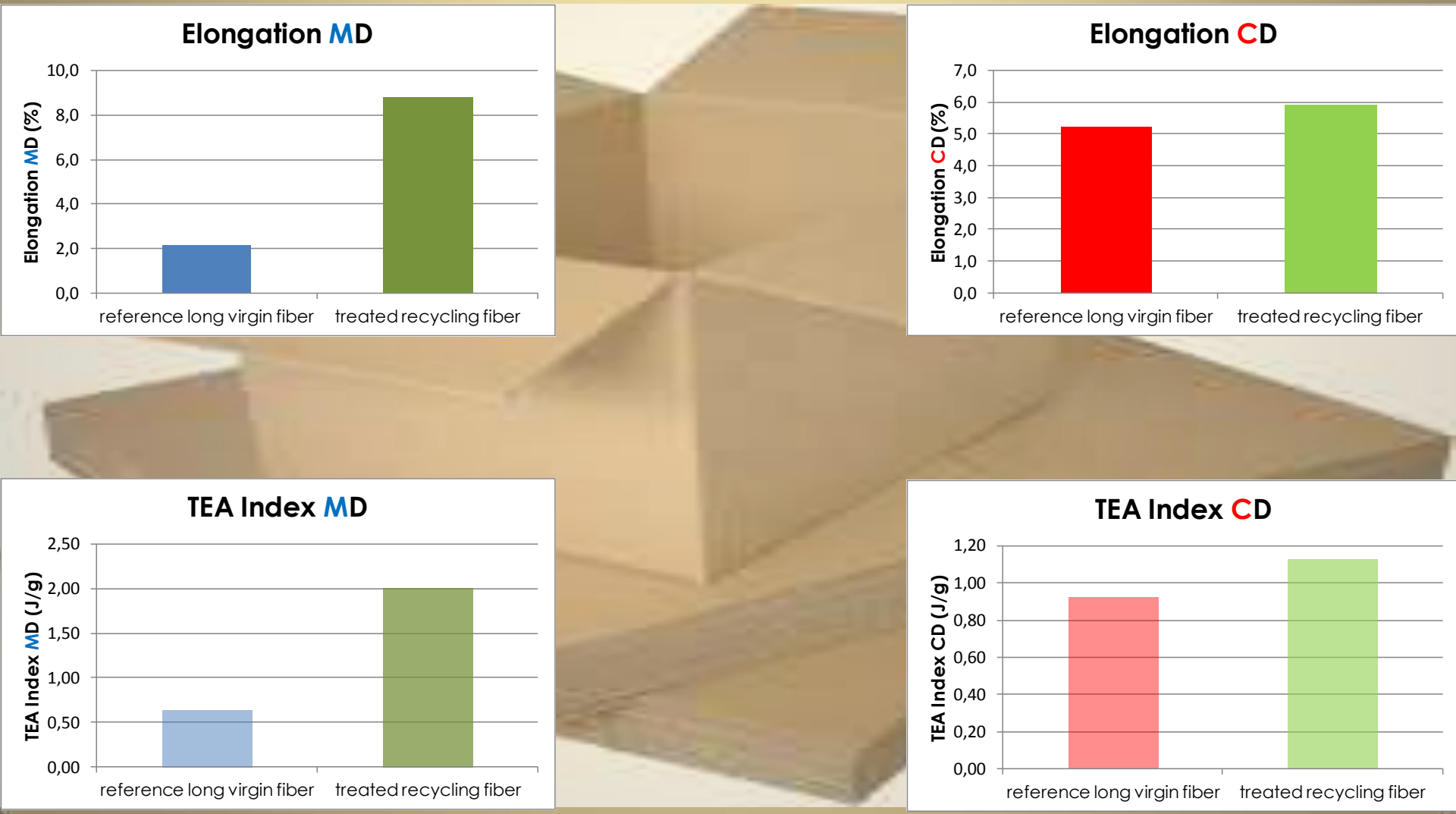




target 2: simulation of vergin fiber

Used pulp: 30% unbleached kraft and 70% OCC, final 28° SR

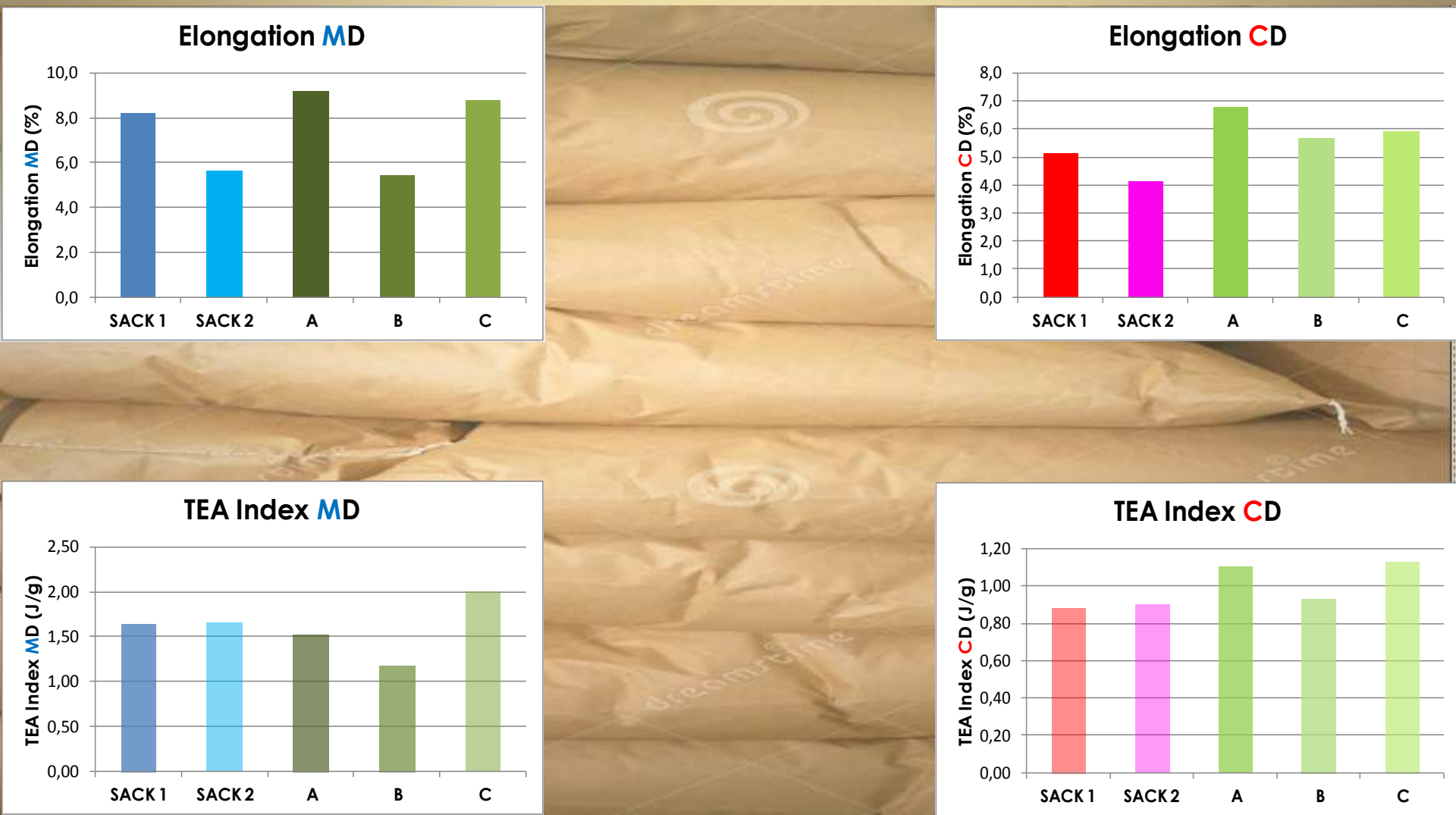
Result: recycling fiber, apart from increased elongation, also increase of TEA in **CD** and **MD**, better than the untreated reference in pure long virgin fiber,30°SR



target3: simulation of standard sack kraft

Used pulp: 30% unbleached kraft and 70% OCC, final 28° SR

Result: elongations could be reproduced or increased. In almost all cases also TEA was improved .Being our system flexible there is still space for fine-tuning



hypothesis on cost saving for sack paper

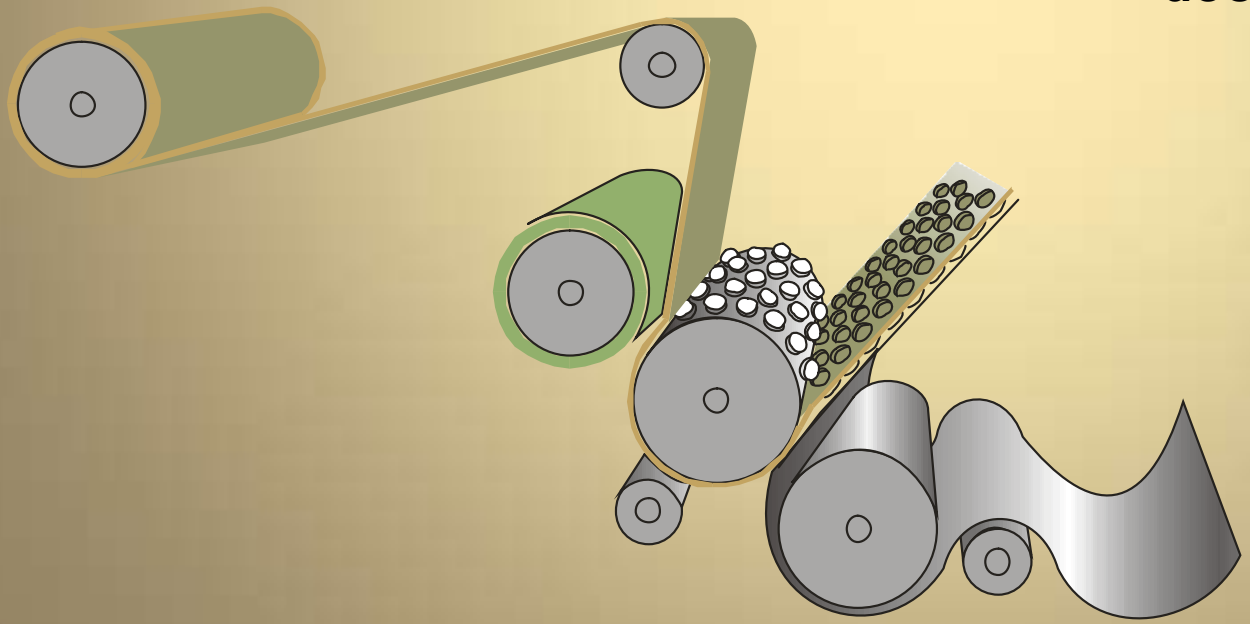
Example of an Italian paper mill for sack paper: production 70.000 ton/year of paper of pure virgin long fibre.
Partial substitution of long vergin fibre with i.e. long recycling fiber, maintaining same elongation performance

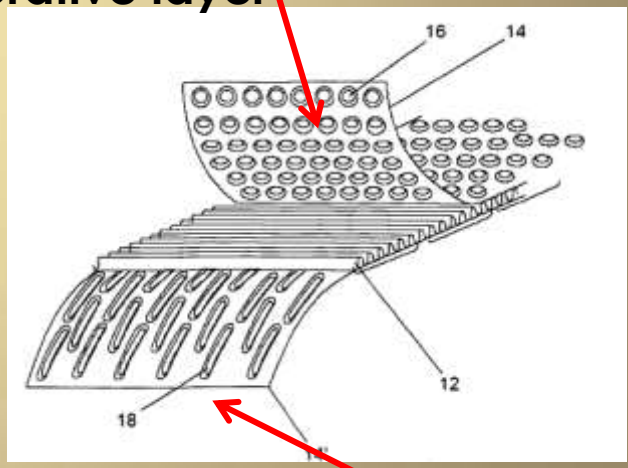
A)Cost 100% long vergin fibre	600 $/ton	
General costs	200 $/ton	
Tot	800 $/ton x 70.000 ton	= 56.000.000 $ cost
B)Cost 90% long vergin fibre	540 $/ton	
Cost 10% long recycling fibre	30 $/ton	
	570 $/ton	
General cost	200 $/ton	
Tot	770 $/ton x 70.000 ton	= 53.900.000 $ cost
		= **2.100.000 $ saving**
C)Cost 50% long vergin fibre	300 $/ton	
Cost 50% long recycling fibre	150 $/ton	
	450 $/ton	
General costs	200 $/ton	
Tot	650 $/ton x 70.000 ton	= 45.550.000 $ cost
		=**10.450.000 $ saving**

a look on corrugated board

recycling paper is widely used for production of corrugate board (liner, fluting)

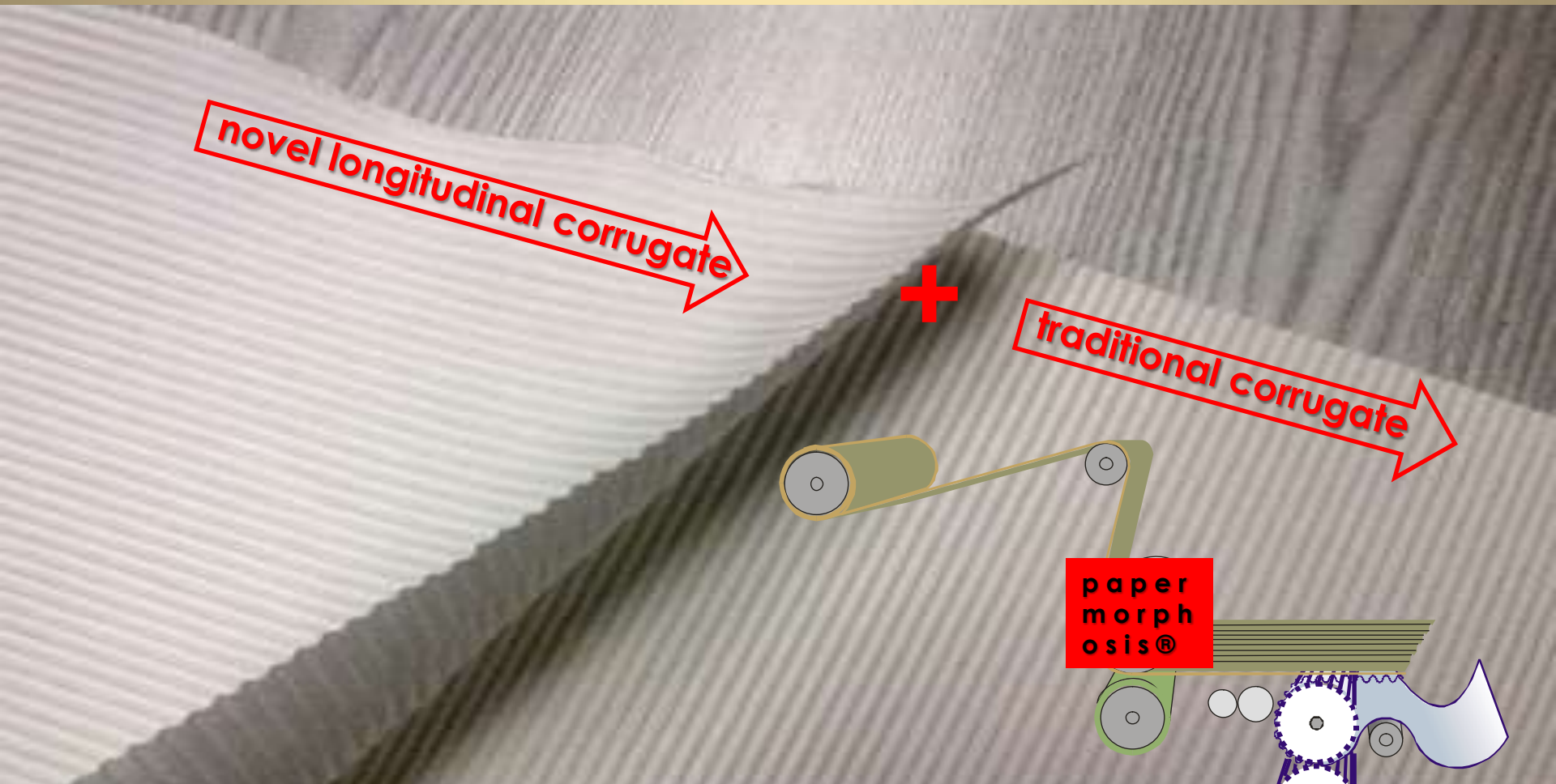
only with stretchable paper even more personalized structures can be generated....





what else?

with **p a p e r m o r p h o s i s ®** a totally new type of corrugate can be produced for additional bi-directional reinforcement



location of the UNITS today

For the development of MOULD PAPER we worked at full industrial scale on a 2,50m wide papermachine at a mill in Italy. Today we have installed our UNITS at the “FEX”-pilot paper line at the paper science and research institute Innventia AB in Stockholm/Sweden.

There we are processing the standard available machine width (240 mm). All sorts of furnishes can be produced to be then processed on our UNITS, evaluations are carried out according international standards

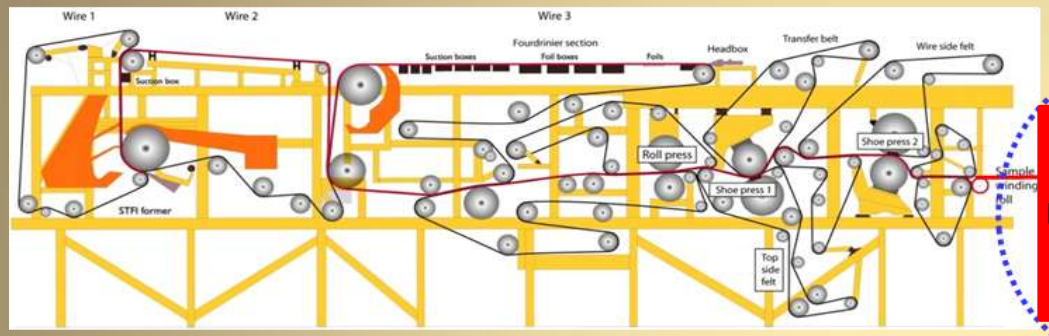
the UNITS within a paper process

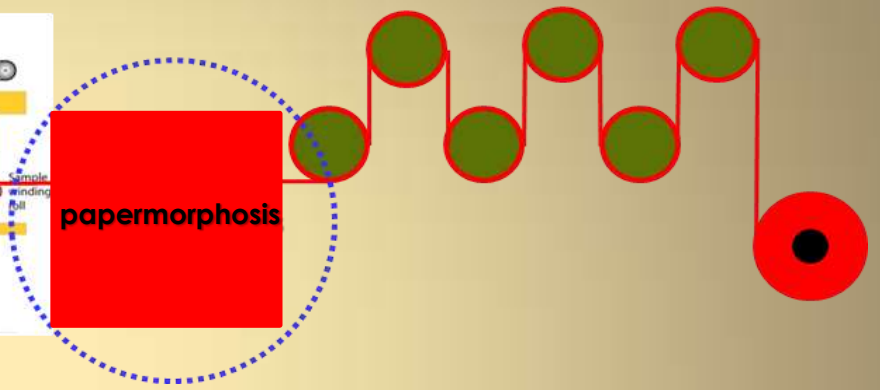
The pilot line is split between press section and a separate dryer allowing the simulation of processes implemented at different positions in a paper machine.

FEX pilot paper machine

at Innventia

Multi-cylinder Drier





industrially

Forming section

Press section

Drying section

Dry content 50% or less for CD-treatment

Dry content about 65% for MD-treatment

outlook

we saw that **p a p e r m o r p h o s i s ®** with its UNITS as a "personal tool for papermakers" can process recycling paper the same way as specialty and high performance papers in terms of:

- ✓Adding performance
- ✓broadening applications
- ✓invading new fields and markets

making every recycling paper a **high performance and specialty paper**!

Many thanks for your attention!