Decrease in strength along a process line for SC paper

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HC Bleaching

Refiners

Standpipe

MG storage

Mixer

HC Bleaching

Standpipe

MG storage

Pulp chest

Post-refining

Tensile index (kNm/kg)

Δ≈2-4 (kNm/kg)

Δ≈2-7 (kNm/kg)

50 kg/t H₂O₂  NaOH:Mg(OH)₂
This is true in a clean system (lab). Na base and thus high initial pH

Engstrand et al.
Fresh fines in distilled water

Fresh fines + DCS from press

Fines from press effluent, more or less DCS

Fig. 9. Effect of the amount of DCS in the water phase during sheet making on the tensile index of handsheets containing bleached fines.
Clearly, surface properties were affected.
Tensile index (kNm/kg)

White water fines:
- BDDJ
- Acetone extracted

Fines content (%)

The decrease in tensile index at the first dilution after refining shows no clear relation to specific energy or if high or low bleaching was run at the time.
Effect of first dilution simulated in the lab.
Strength decrease over bleach tower

Δ Tensile index (Nm/g)

Peroxide dosage (kg/admt)
5 samples x 4 during 24hrs:

Mix from 3 refiners
Surface composition, atom-%
ESCA – Electron Spectroscopy Chemical Analysis (XPS – X-ray --), max depth 100Å

Estimated surface coverage of extractives:

\[
\begin{bmatrix}
\frac{O}{C}
\end{bmatrix}_{Sample} = \phi \begin{bmatrix}
\frac{O}{C}
\end{bmatrix}_{"Dirt"} + (1 - \phi) \begin{bmatrix}
\frac{O}{C}
\end{bmatrix}_{Extracted}
\]
Surface composition, atom-%
ESCA (XPS), max depth 100Å

Estimated surface coverage of extractives:

\[
\left[ \frac{O}{C} \right]_{Sample} = \phi \left[ \frac{O}{C} \right]_{"Dirt"} + (1 - \phi) \left[ \frac{O}{C} \right]_{Extracted}
\]

Estimated surface coverage, extractives (%)
from C-C, [O/C] gives the same pattern

R33  Standpipe  Before bleaching  After
Conclusions

Tensile index decreases 1-4 units in the first dilution after refining and up to 7 units in bleaching

The fiber surfaces become more hydrophobic / contact angle increase

Bulk extractive content increase but no correlation to tensile index

Acetone washing can restore a big part of the tensile index

Surface composition (ESCA) => higher surface coverage of extractives; triglycerides, fatty and resin acids.

Some decrease remains to be investigated