SURFACE CHARACTERISTICS OF HANDSHEETS MADE FROM DIGITAL PRINTED DEINKED PULP

Branka Lozo, Vesna Džimbeg - Malčić, Damir Modrić,
Željka Barbarić - Mikočević
Faculty of Graphic Arts, University of Zagreb, Croatia

The scope of the investigation

- Laboratory recycling process
- Input raw material: conventional and digital offset prints
- Handsheets: comparison and analysis

Input raw material

Conventional offset prints:

- KBA web offset, Slobodna Dalmacija, Split, Croatia
- 45 g/m² newsprint paper (10% fillers), Zagrebačka tvornica papira

Digital offset prints:

- Indigo E-Print 1000+. Faculty of Graphic Arts, Zgb.
- 130 g/m² matt coated paper (28% fillers), Fedrigoni

Newsprint paper

Functional point of view:

- optical properties
- mechanical properties → web printing

Manufacturing point of view:

- low grammage
- raw material: cca 7/10 ONP
  cca 3/10 primary fibers or OMG

Changes in fibers due to recycling

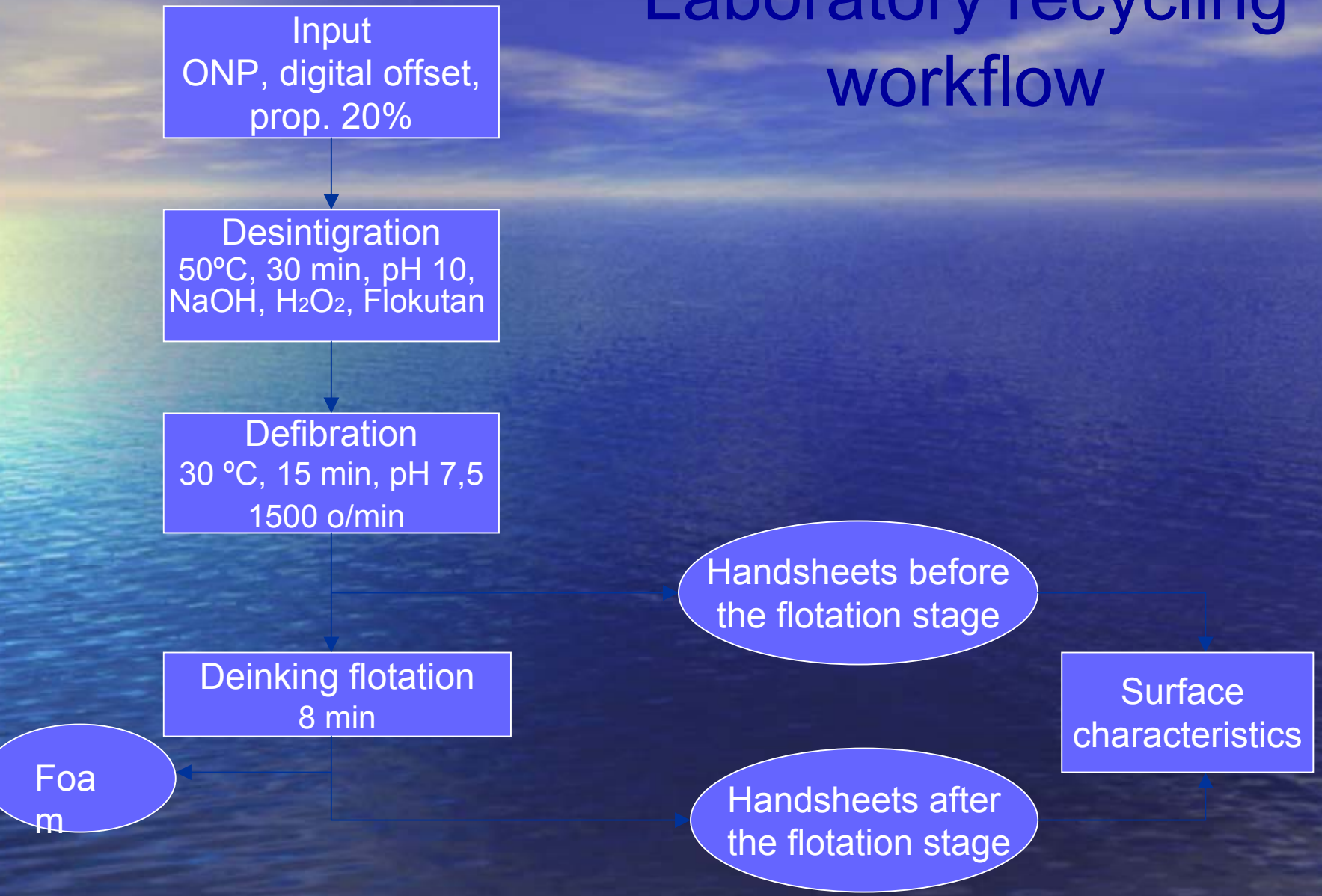
- loss of water during drying
- tightening of lamellas in the cell wall
- irreversible cornification
- brittle, breakable, shorter
- $Z_s(t) \approx$ const.
- reduction of swelling capacity
- reduced flexibility
- low adherence among fibers
- weak interfiber bonding
- low specific strength of bonding

Dirt specks in recycled paper

- Ink particles
- Stickies
- Fines: fiber fines
  fillers
  other

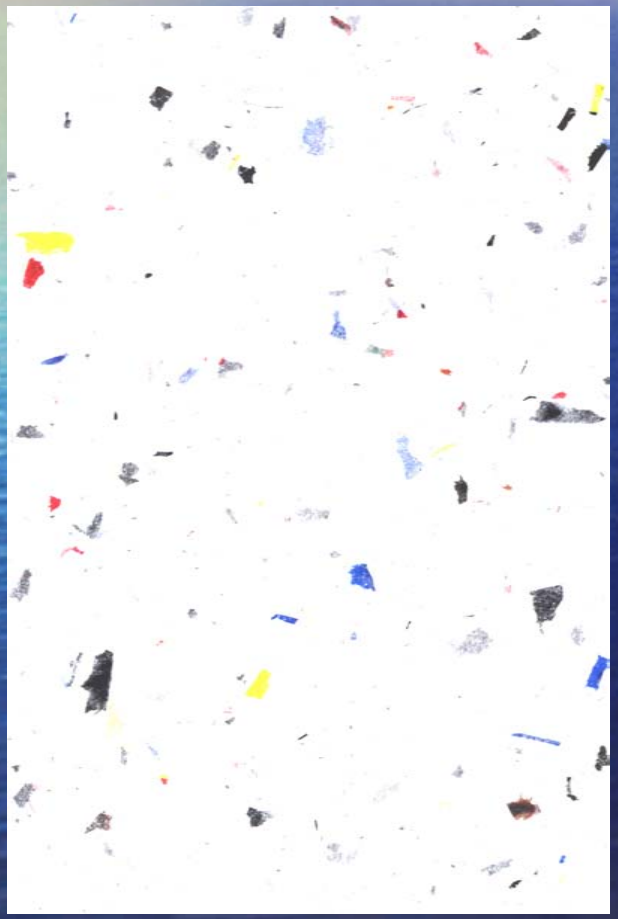
Limited flotation efficacy: 20 – 200 µm (Borchardt,1997)
40 – 250 µm (Magde, Lee, 1998)
opt.: 30 – 80 µm (Borchardt,1997)

Laboratory recycling workflow



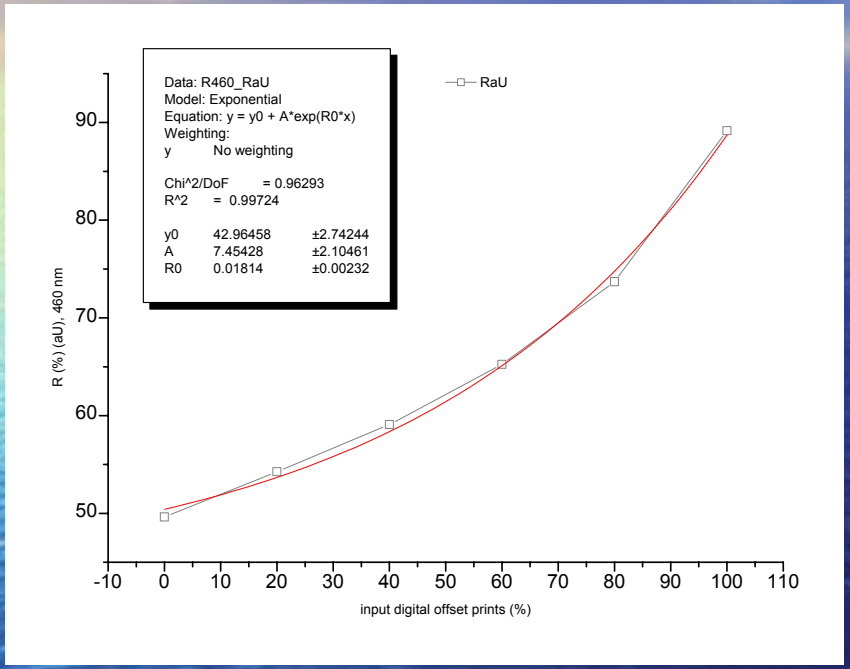
Recycled handsheets

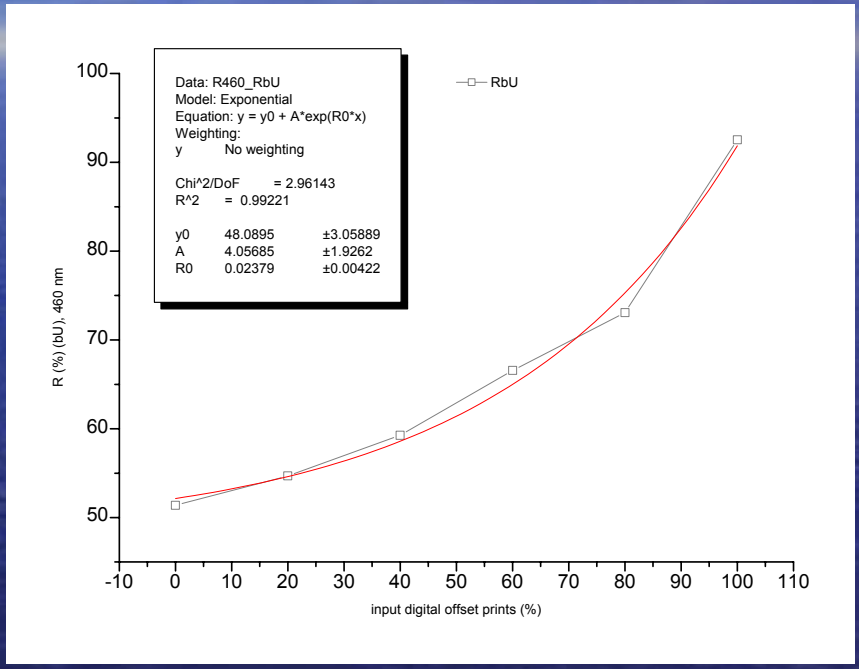
Digital offset prints



ONP

Brightness, ISO 2470



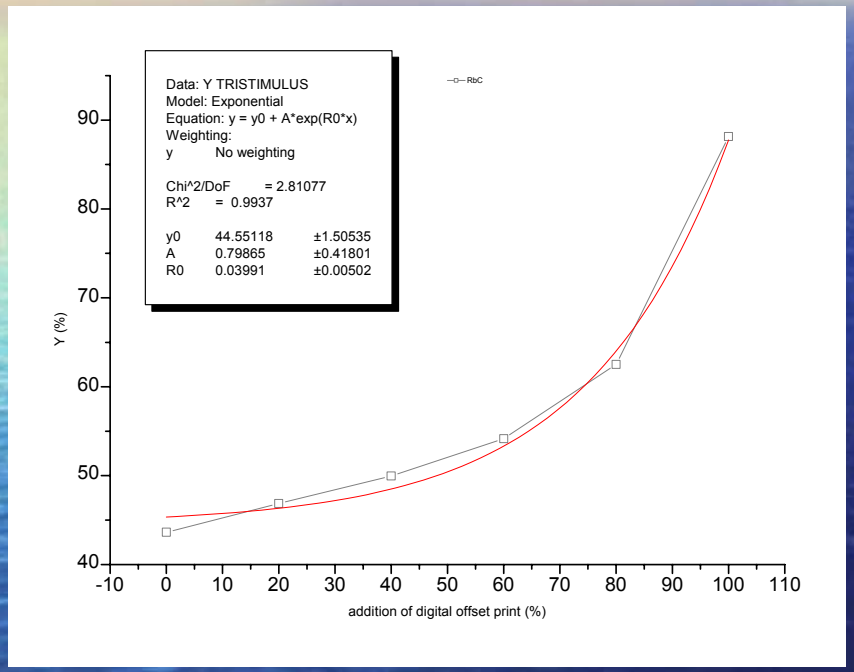


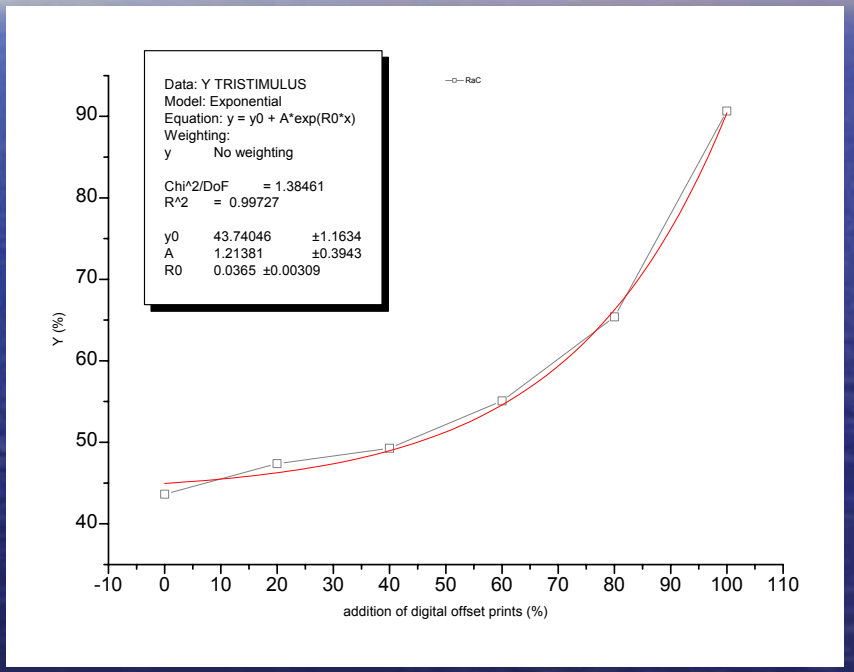
Before the flotation stage

After the flotation stage

Reflectance 471 nm; X-Rite spectrophotometer

Y – tristimulus value





Before the flotation stage

After the flotation stage

X-Rite spectrophotometer

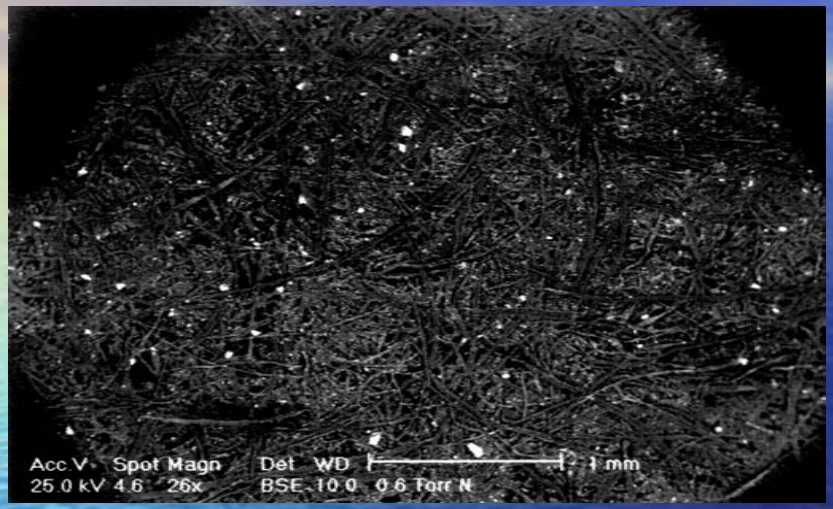
Environmental Scanning Electron Microscopy

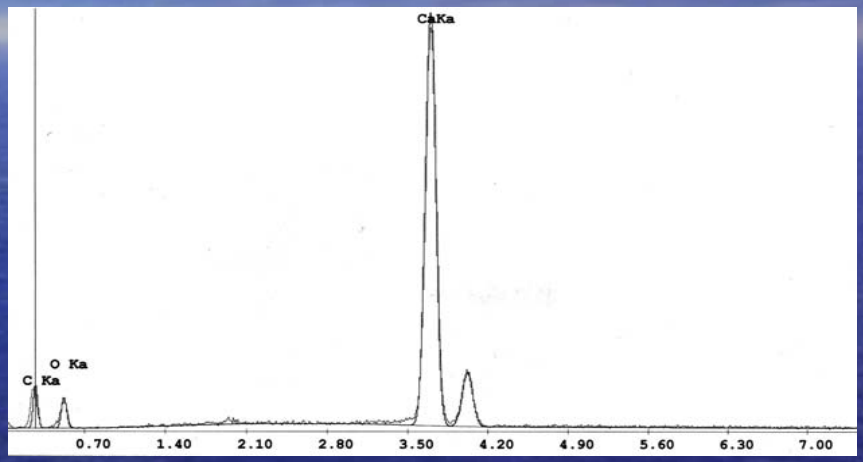
ESEM technique:

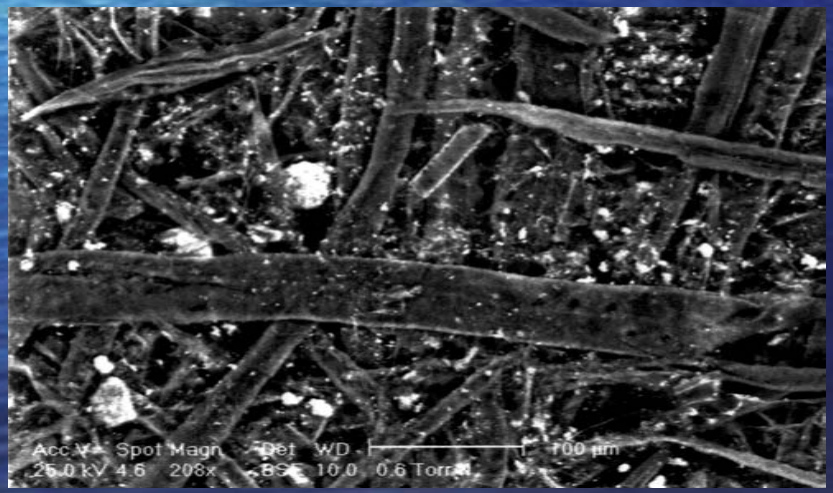
- pecimens are observed in their natural, moist state, i.e. no conductive coating
- wo separate chambers:
  - high vacuum electron column
  - low vacuum sample chamber
- SD, environmental secondary detector, X-ray spectroscopy

PHILIPS ESEM XL30

ESEM image, X-ray spectroscopy, specimen map





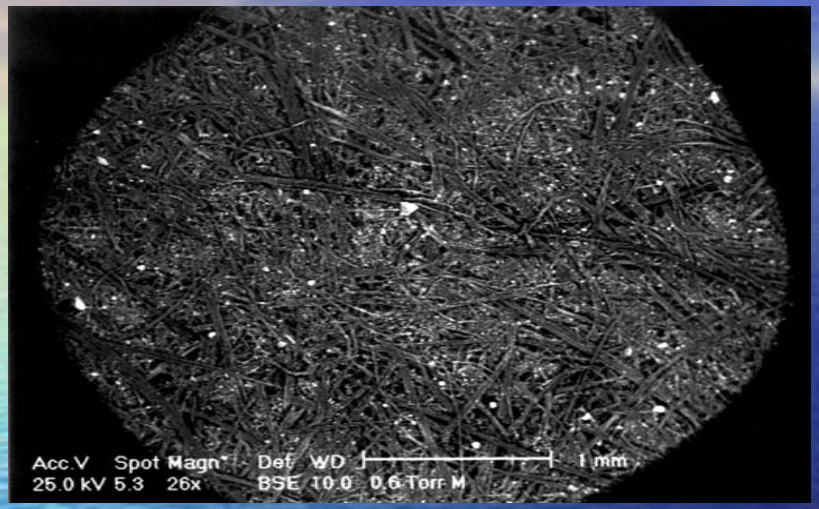


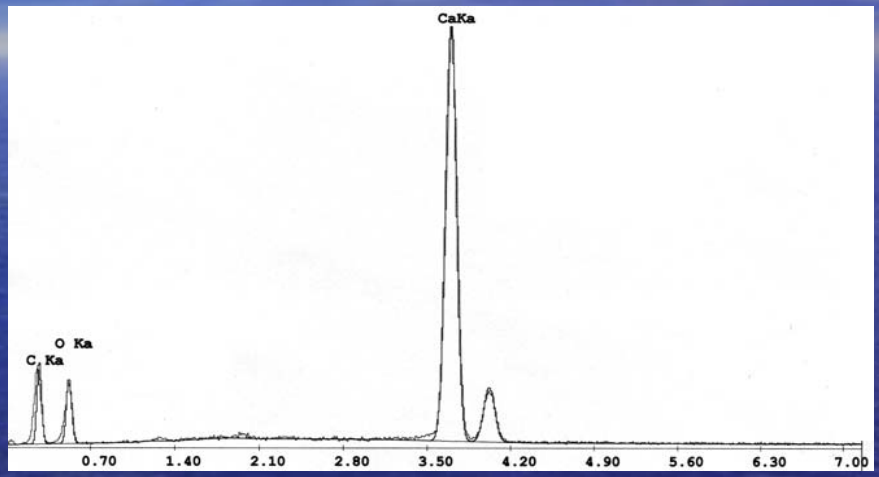
Element	Wt %
C K	21.13
O K	24.59
CaK	54.28
Total	100.00

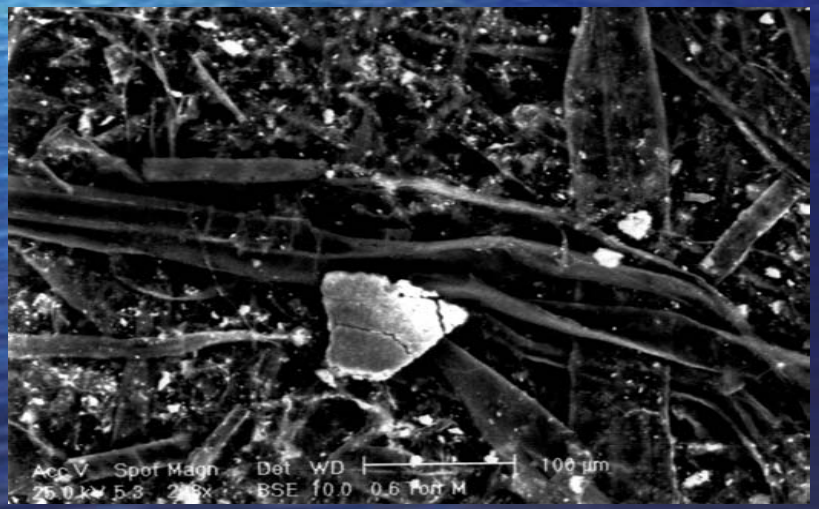
Conventional offset print (ONP)

Handsheet before the flotation stage

ESEM image, X-ray spectroscopy, specimen map





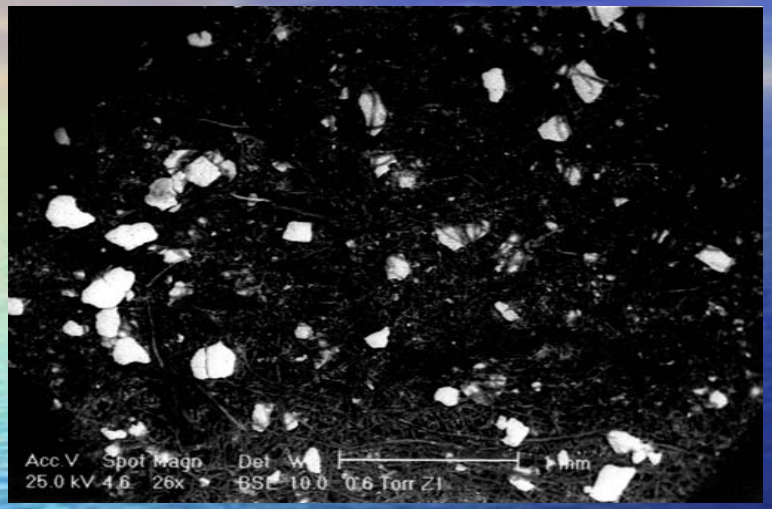


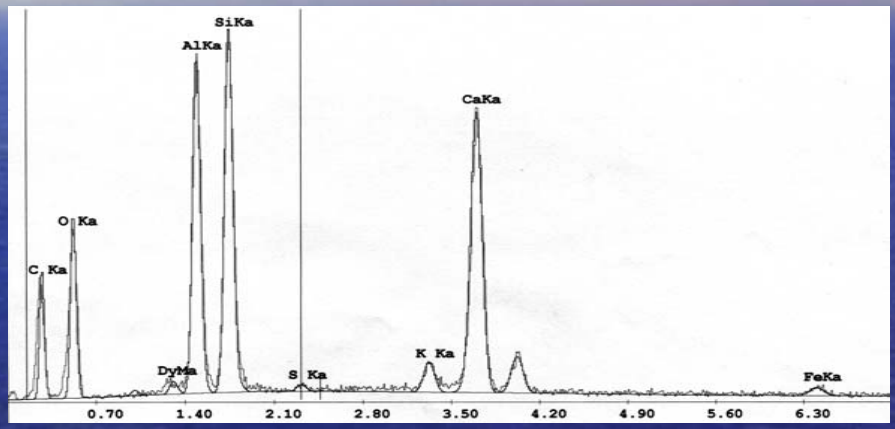
Element	Wt %
C K	28.01
O K	32.12
CaK	39.87
Total	100.00

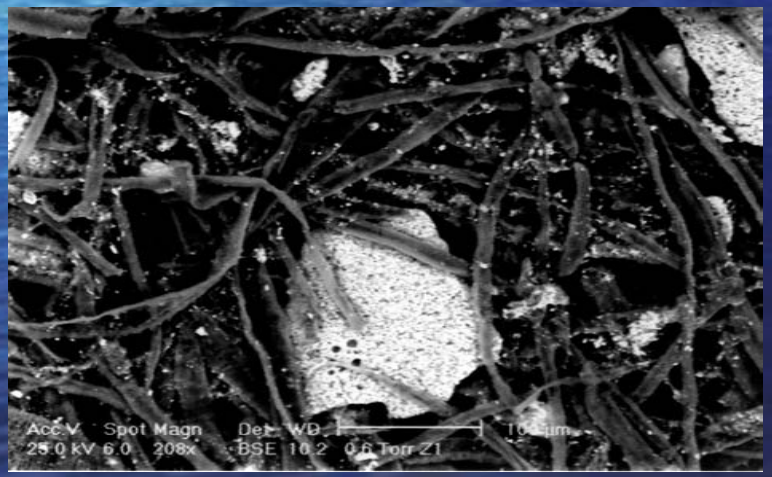
Conventional offset print (ONP)

Handsheet after the flotation stage

ESEM image, X-ray spectroscopy, specimen map





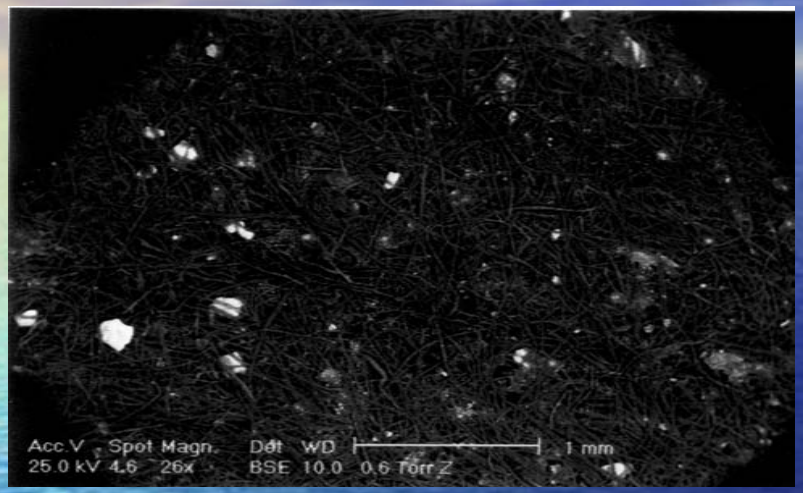


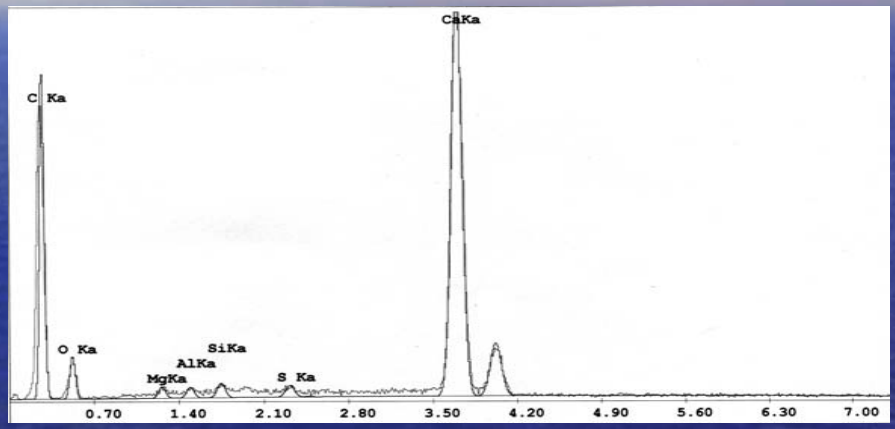
Element	Wt %
C K	36.21
O K	26.35
DyM	2.22
AlK	9.80
SiK	11.73
S K	0.23
K K	1.09
CaK	11.51
FeK	0.86
Total	100.00

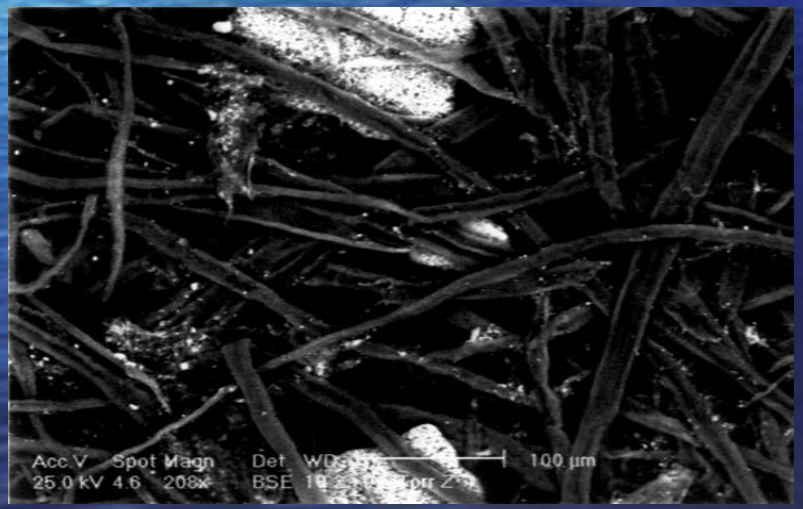
Digital offset print (Indigo)

Handsheet before the flotation stage

ESEM image, X-ray spectroscopy, specimen map





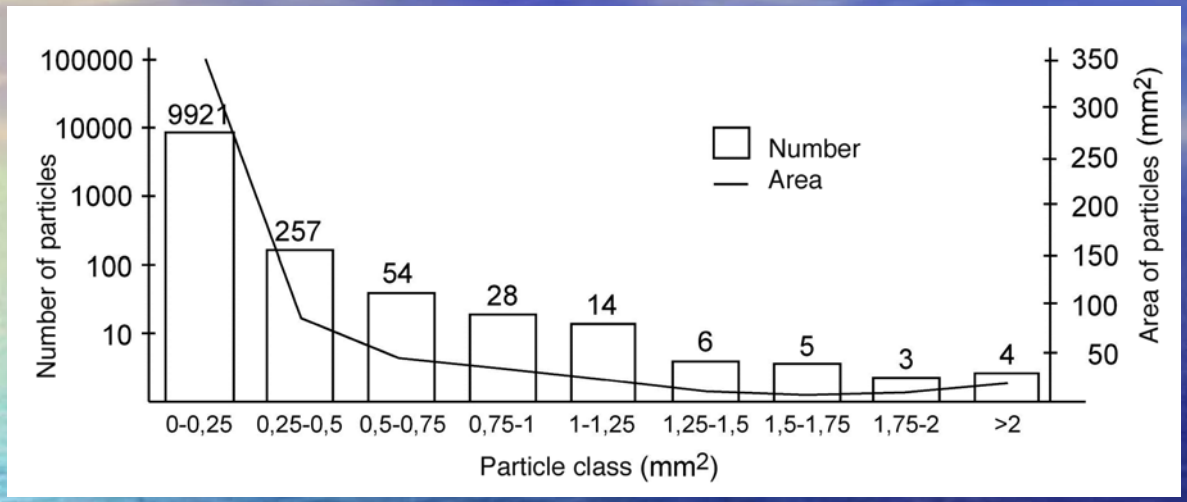


Element	Wt %
C K	60.63
O K	13.51
MgK	0.65
AlK	0.48
SiK	0.59
S K	0.46
CaK	23.68
Total	100.00

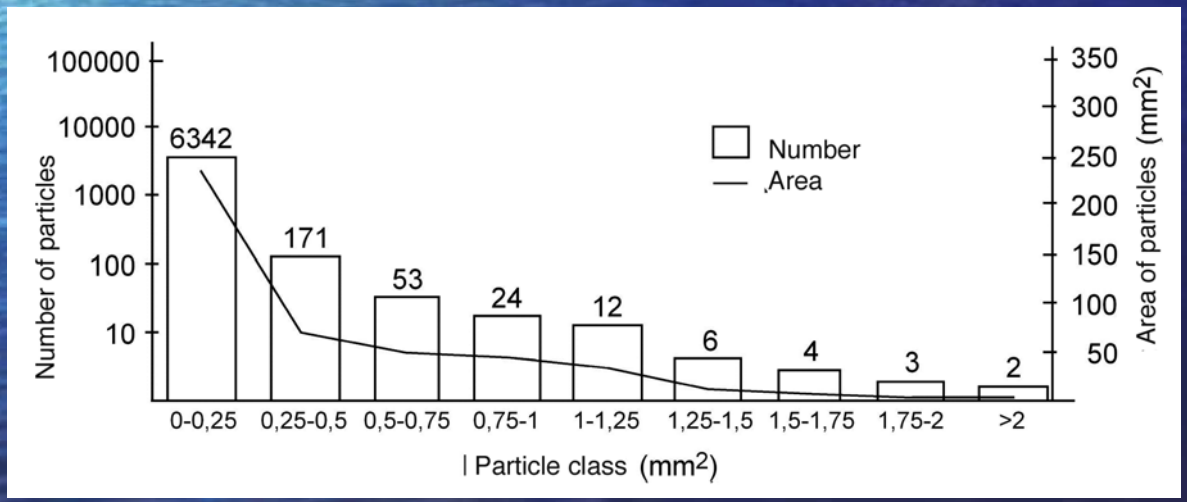
Digital offset print (Indigo)

Handsheet after the flotation stage

Image analysis: Conventional offset



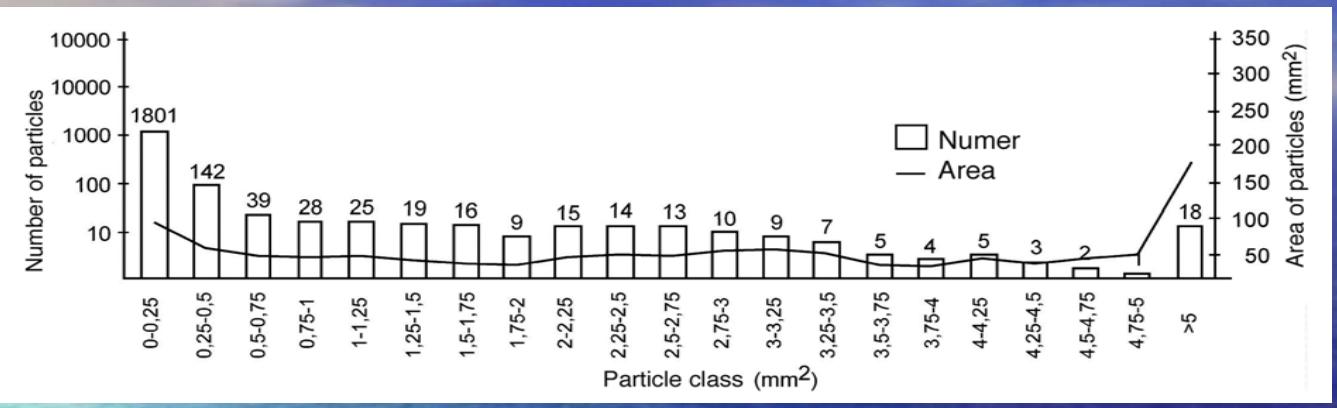
Before the flotation stage



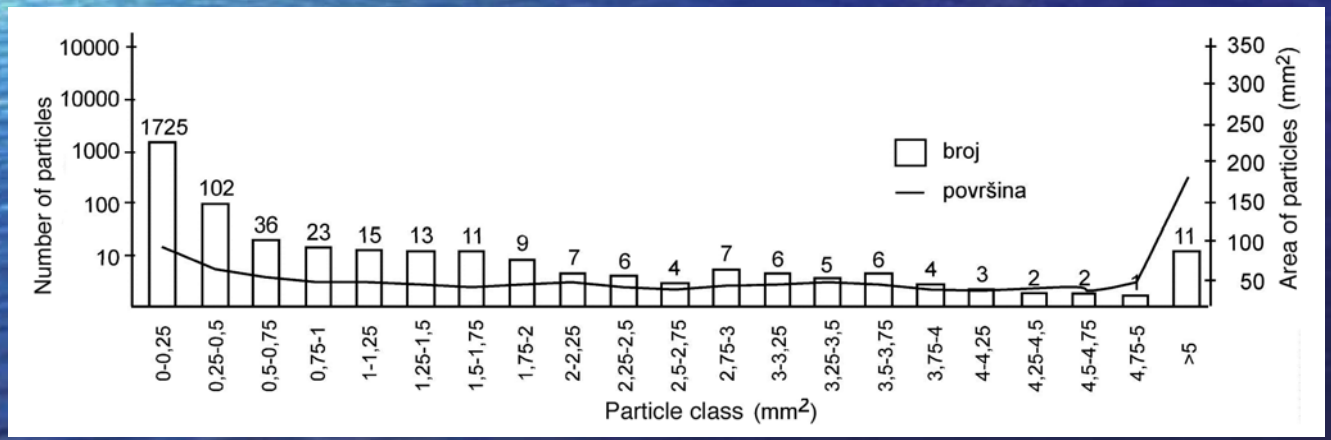
After the flotation stage:

Δ 35,8 % ink particles

Image analysis: Digital offset



Before the flotation stage



After the flotation stage:

Δ 8,6 % ElectroInk particles

Final comments

- Conditions of desintegration?
- Duration of flotation?
- Pretreatment?