



FIBRE based solutions

Evaluation of the disintegration behavior

Fibre box

cyclos-HTP sample No.: 2782-2024-004108

Project no.: 2782-001-2024

March 2024



Testing Service



Industrial
Solutions



Products



Research



Events

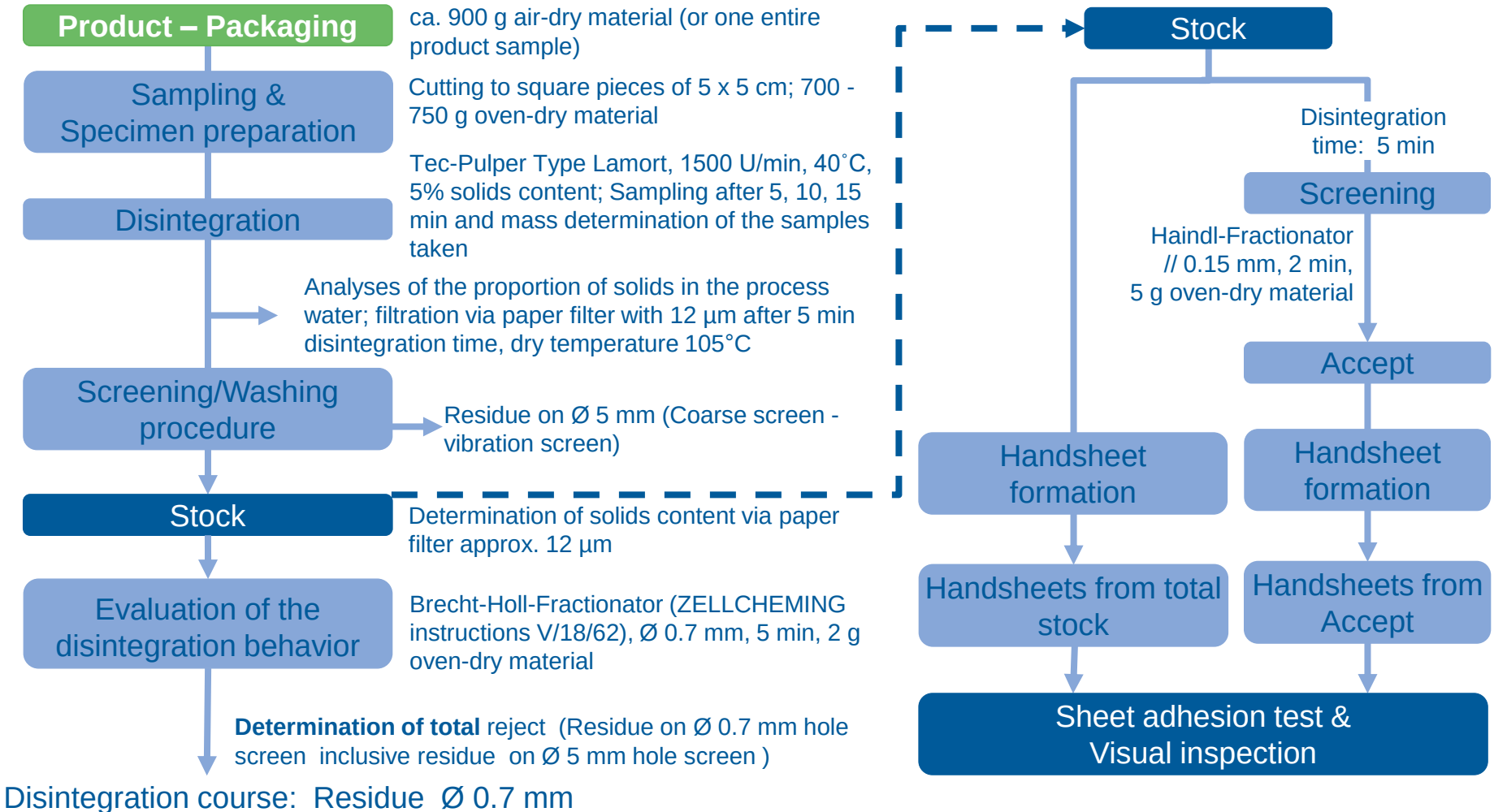
Task by cyclos-HTP

- Evaluation of the disintegration behavior of a fibre box.
- Cyclos-HTP assigned the samples to be tested to typical utilization ways of recovered paper processing: It is assumed that the material is utilized in recovered paper processing as a component of mixed paper and board or as a component of Paper, Board, Cardboard from Light Weight Packaging.
- In particular, it has to be evaluated whether the slushing times commonly used for these recovered papers are adequate to suspend the samples and to evaluate the behavior and amount of rejects which are to be expected to accrue.
- Based on disintegration tests under defined conditions performed with a Laboratory Pulper (design type: LAMORT) the disintegration behavior / recyclability of the material has to be evaluated.

1. Overview process scheme
2. Investigations in the PTS-Technikum and laboratory
3. Description of the evaluated samples
4. Evaluation of the results
5. Summary evaluation

Overview process scheme

Practical evaluation of the disintegration behavior and disturbing potentials of packaging paper, cardboard and packaging



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Disintegration of the material with Laboratory Pulper

Amount of material: 0.75 kg dry

Tap water: 14.2 l

Start water temperature: 40°C

Material just fed into the Lab-Pulper –
feeding within 2 min at 750 rpm

Rotor speed: 1500 rpm

Solid content of suspension: 50 g/l

Sampling intervals:

5 min

10 min

15 min



Laboratory pulper



Utilized
Pulper
Rotor
(LC)

Estimation of large scale particles (paper, plastic) reject rate by screening and washing - coarse screening (vibration screen)



Reason for this way of procedure:

Large scale particles make the evaluation of the disintegration course by means of the BRECHT/HOLL – Fractionation impossible.

The 0.7 mm holes of the screen plate would be blocked by paper and plastic particles.

Procedure

Stock sample have been taken out of the pulper after disintegration time

Stock sample filled up to 25 liters and was transferred into a vibration screen

Washing and screening for 5 min with a Ø 5 mm hole plate

Manual take out of the screened large scale pieces and drying for 24 hours at 75 °C ; weigh of the dried pieces

The remaining sample (suspension without large scale paper pieces) was fractionated (BRECHT/HOLL) - Fractionation according to PTS- method PTS-RH:021/97 (Draft Oct 2019)



Vibration screen with hole plate (Ø 5 mm)



BRECHT/HOLL - Fractionation

Equipment according to ZELLCHEMING instructions V/18/62



BRECHT/HOLL - Fractionation

Equipment according to ZELLCHEMING instructions V/18/62



Screening element	Hole plate
Hole Ø	0.7 mm
Number of holes	870
Distance between holes	5.0 mm
Sample mass (bdm)	2.0 g
Suspension volume	0.8 dm ³
Filling time	0.5 min
Total wash- and filling time	5.0 min
Water pressure	30 kPa
Membran oscillation	6.0 mm



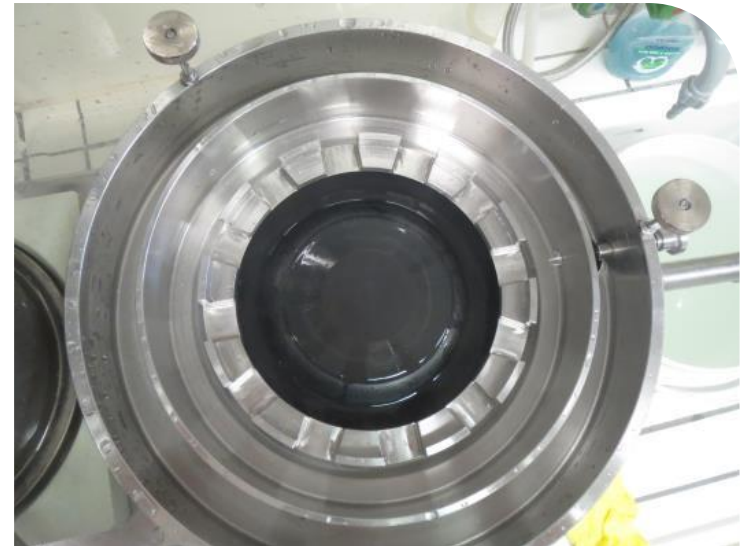
0.7 mm Hole plate

Haindl - Fractionation

Equipment according to ZELLCHEMING instructions V/1.4/86



Haindl-Fractionator - Overall view



Haindl-Fractionator - Membrane

Haindl – Fractionation

Set parameters and equipment according to ZELLCHEMING instructions V/1.4/86 and PTS- method PTS-RH:021/97 (Draft Oct 2019)



Screening element	Slotted plate
Size of the slots	0.15 mm
Sample mass (oven-dry material)	5.0 g
Suspension volume	2.0 l
Filling time	15 s
Total time	2.0 min
Double strokes	200 min-1
Water feed by bunching nozzle	7.5 l/min
Membran oscillation	18 mm



0.15 mm slotted plate

Sheet adhesion test according to PTS-RH:021/97 (Draft Oct 2019) “Assessment of the recyclability of packaging products made of paper and board”



For the sheet adhesion test, the dried handsheets (handsheets are formed from the accepts from the Haindl-slot screening) together with a couch carrier board and a cover sheet are sandwiched between two brass plates and placed in a drying oven where a full-surface pressure of 1.18 kPa is applied for 2 minutes.

Next, the specimens are placed in an exsiccator where they are allowed to cool down for 10 minutes, then they undergo the sheet adhesion test and the visual inspection for any optical inhomogeneities.

The carrier board and the cover sheet are one by one and slowly peeled off the handsheets. While doing so, the test operator will check for potential adhesion effects. Also, the surfaces of the handsheet, cover sheet and carrier board are inspected for any damage or adhesions to the handsheet.



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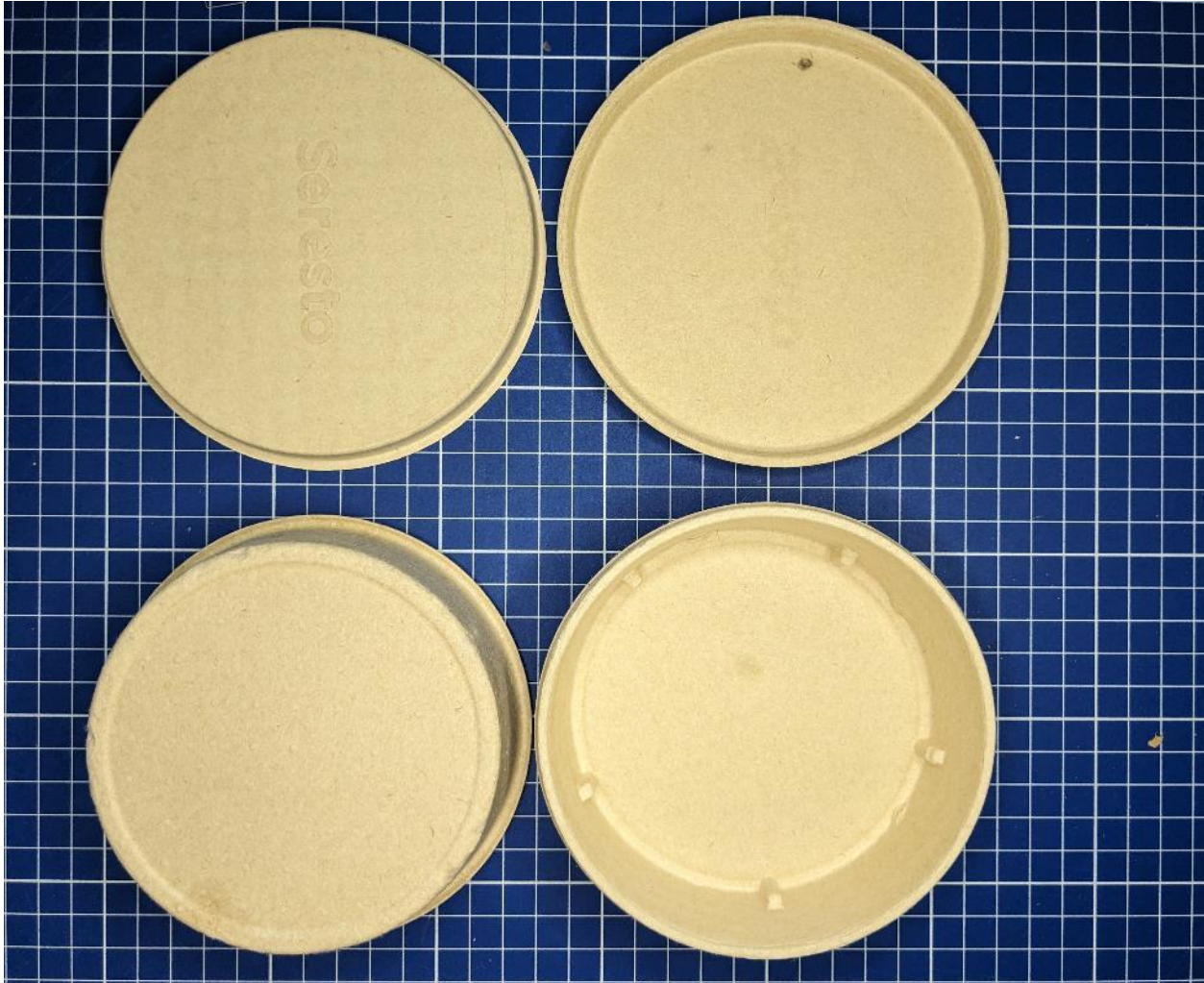
Description of the evaluated sample based on visual and haptic inspections



- The sample tested is a fibre-based box with a lid, which is also made of fibre material.
 - The box and the lid are made of light brown fibre material.
 - No adhesions or coatings are visible on the sample.
 - The sample is unprinted.
-
- The material composition of the sample was not analysed chemically or by spectroscopy.
 - A possible interference potential of substances discharged by the sample to the process water was not determined within the scope of the investigation carried out.

Description of the evaluated sample

General view of the sample



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Material feed into the Laboratory Pulper

Original sample	Dryness [%]	Feed of material- air dry [g]	Feed of material dry [g]
Fibre box cyclos-HTP sample No.: 2782-2024-004085	93,1	806	750

Size of the fed materials

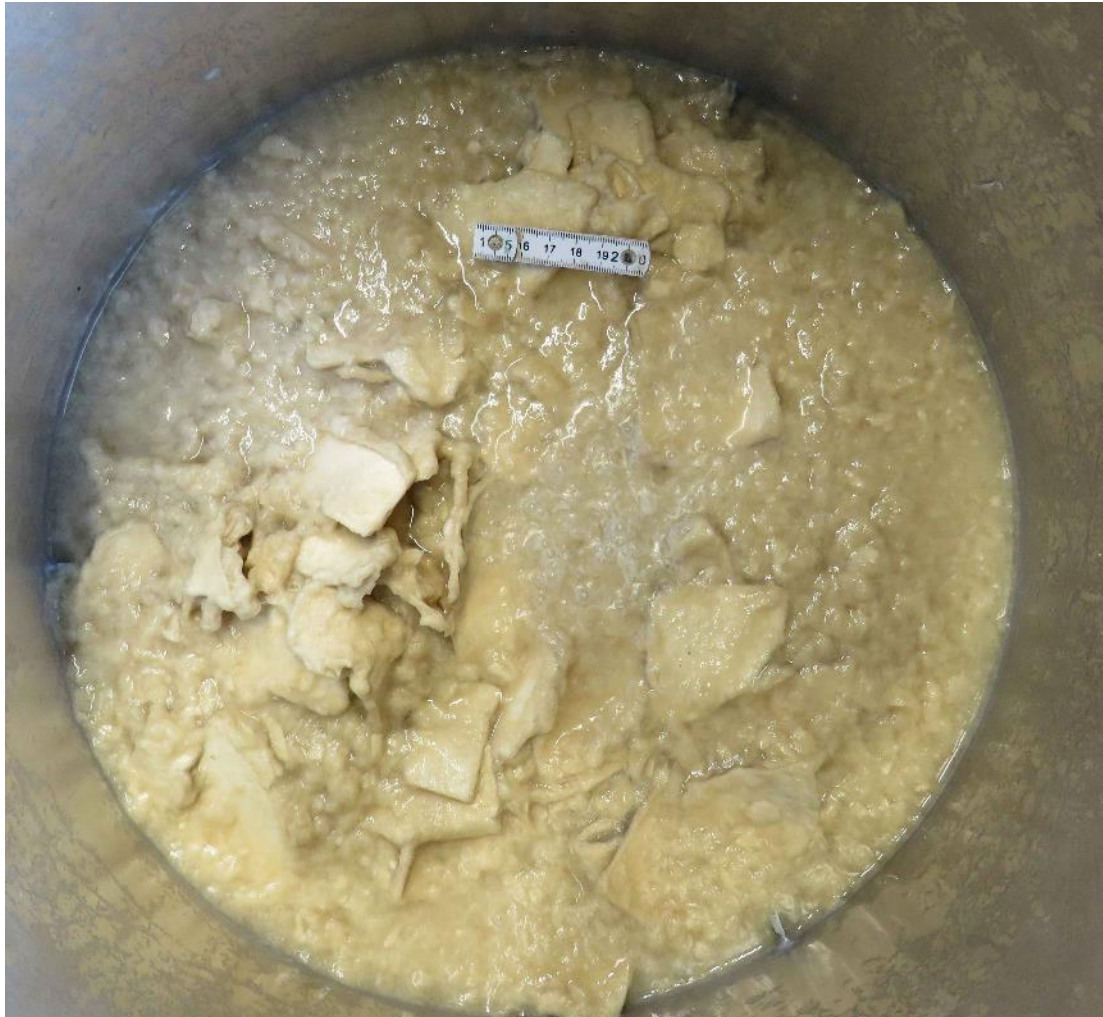
approx. 5 cm x 5 cm



Tested material before fed into the pulper

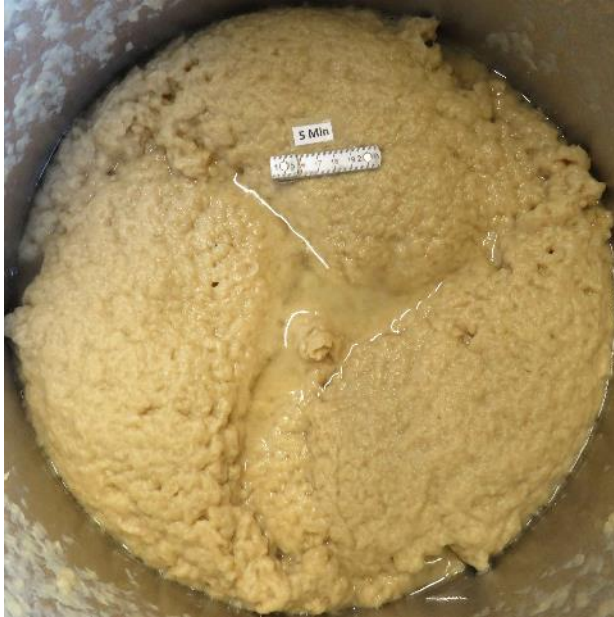
Material feed into the Laboratory Pulper

Optical appearance of the sample – after feed into the Laboratory Pulper feeding within 2 min at 750 rpm



Optical appearance of the treated sample – after different disintegration time

after 5 min disintegration



after 10 min disintegration



after 15 min disintegration



Pulp - Temperature development

Disintegration time [min]	5	10	15
T Pulp [°C]	40.8	42.9	43.4

Disintegration course

The share of large pieces with adherent fibres related in the disintegrated stock (total solid) - taken after pulping and screening (Residue on hole screen Ø 5.0 mm)



Fibre box		cyclos-HTP sample No.: 2782-2024-004108		
Disintegration time	Mass of the total sample (analytically determined as filterable solid and rejects (dry))	Residue on 5.0 mm Hole Screen (vibration screen) - dry	stock sample - dry	Share of Residue on 5.0 mm Hole Screen - dry / total sample
[min]	[g]	[g]	[g]	[%]
5	108,0	0,0	108,0	0,0
10	105,0	0,0	105,0	0,0
15	104,0	0,0	104,0	0,0

Disintegration course

Share of fibre fraction not disintegrated "flakes" and other particles which do not pass the hole plate due to their size and/or shape -
Residue of BRECHT-HOLL-Fractionation



Fibre box		cyclos-HTP sample No.: 2782-2024-004108						
Disintegration time	Individual values of Brecht-Holl Fractionation (3-fold determination)							
	Value 1	Value 2	Value 3	Average	Value 1	Value 2	Value 3	Average
[min]	[g/2 g]	[g/2 g]	[g/2 g]	[g/2 g]	[%]	[%]	[%]	[%]
5	0,069	0,043	0,051	0,05	3,5	2,2	2,6	2,7
10	0,035	0,110	0,033	0,06	1,8	5,5	1,7	3,0
15	0,069	0,029	0,047	0,05	3,5	1,5	2,4	2,4

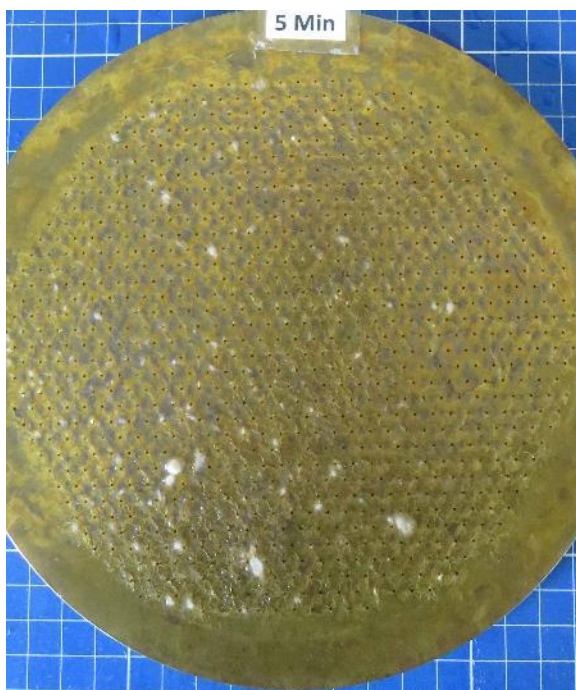
Fibre box			cyclos-HTP sample No.: 2782-2024-004108		
Disintegration time	Mass of the total sample (analytically determined as filterable solid and rejects (dry))	stock sample - dry	Fibre fraction not disintegrated "flakes" -dry / 2 g stock sample	Fibre fraction not disintegrated "flakes" -dry / total sample	Share of fibre fraction not disintegrated "flakes" - dry / total sample
			Residue on 0.7 mm Hole Screen (Brecht-Holl Fractionation)		Share of residue on 0.7 mm Hole Screen (Brecht-Holl Fractionation) - dry / total sample
[min]	[g]	[g]	[g/2 g]	[g]	[%]
5	108,0	108,0	0,05	2,9	2,7
10	105,0	105,0	0,06	3,1	3,0
15	104,0	104,0	0,05	2,5	2,4

Disintegration course

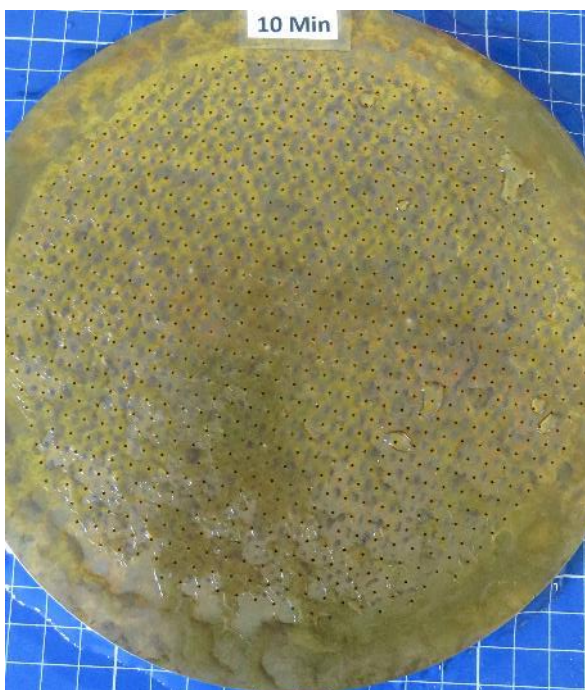
Residue of BRECHT-HOLL-Fractionation - wet (Hole plate 0,7 mm)



after 5 min disintegration



after 10 min disintegration



after 15 min disintegration



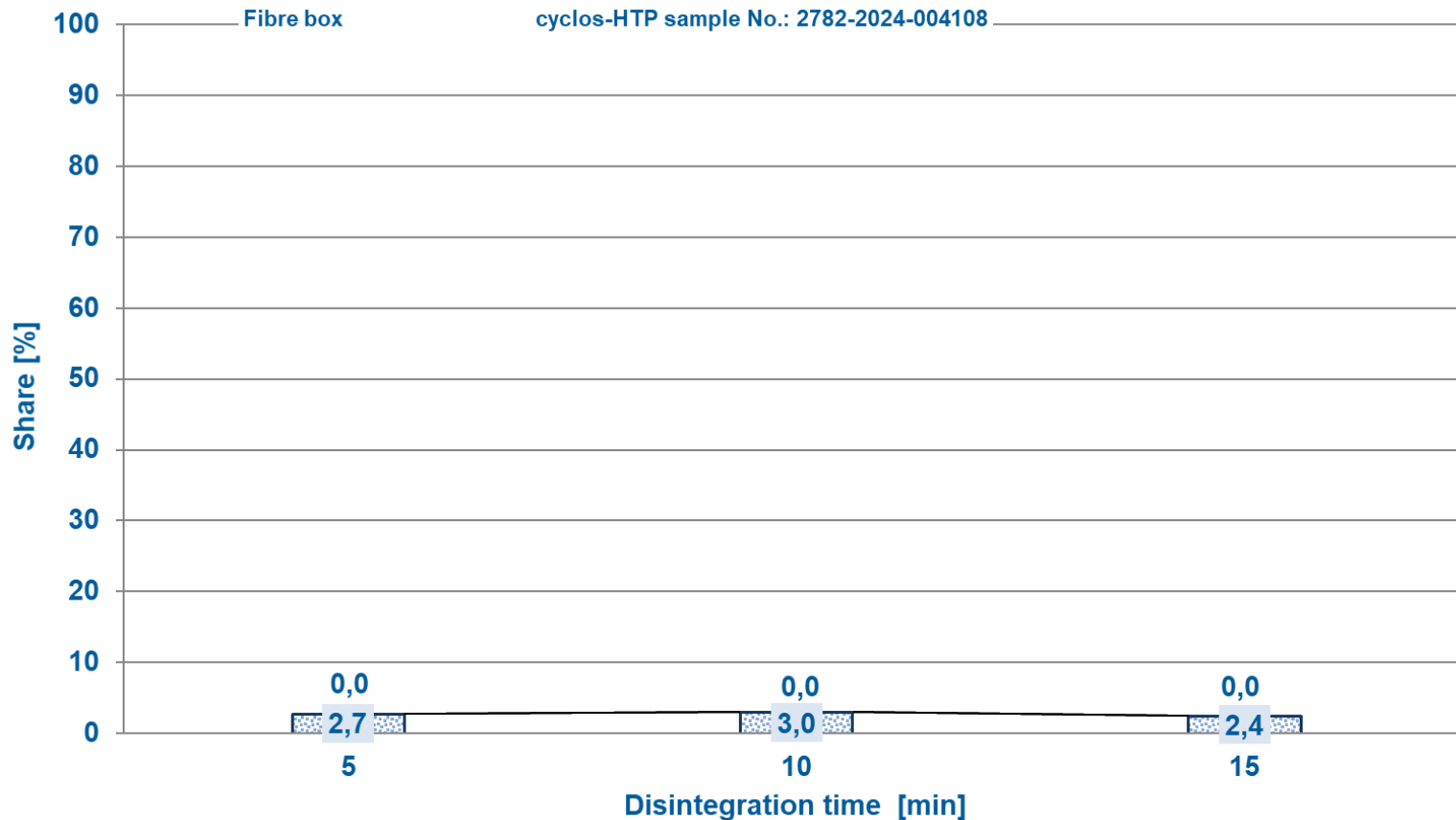
Estimation of reject rate – Share of large pieces with adherent fibres and fibre fraction not disintegrated in the disintegrated stock



Fibre box cyclos-HTP sample No.: 2782-2024-004108										
Disintegration time	Theoretical mass of the total sample (the value is only informative and is not used for further evaluations)	Mass of the total sample (analytically determined as filterable solid and rejects (dry))	Residue on 5.0 mm Hole Screen (vibration screen) - dry	stock sample - dry	Fibre fraction not disintegrated "flakes" -dry / 2 g stock sample	Fibre fraction not disintegrated "flakes" -dry / total sample	total reject (Residue on 5.0 mm and 0.7 mm Hole Screen), dry	Share of Residue on 5.0 mm Hole Screen - dry / total sample	Share of fibre fraction not disintegrated "flakes" - dry / total sample	Share of total reject (Residue on 5.0 mm and 0.7 mm Hole Screen) / total sample
					Residue on 0.7 mm Hole Screen (Brecht-Holl Fractionation)				Share of residue on 0.7 mm Hole Screen (Brecht-Holl Fractionation) - dry / total sample	
[min]	[g]	[g]	[g]	[g]	[g/2 g]	[g]	[g]	[%]	[%]	[%]
5	107,0	108,0	0,0	108,0	0,05	2,9	2,9	0,0	2,7	2,7
10	103,0	105,0	0,0	105,0	0,06	3,1	3,1	0,0	3,0	3,0
15	103	104,0	0,0	104,0	0,05	2,5	2,5	0,0	2,4	2,4

Disintegration course

Estimation of reject rate – Share of large pieces with adherent fibres and fibre fraction not disintegrated in the disintegrated stock



■ Share of Residue on 5.0 mm Hole Screen - dry / total sample

▨ Share of residue on 0.7 mm Hole Screen (Brecht-Holl Fractionation) - dry / total sample

Visual appearance of dried pulp with lab sheets after disintegration - Transmitted light

after 5 min disintegration

after 10 min disintegration

after 15 min disintegration

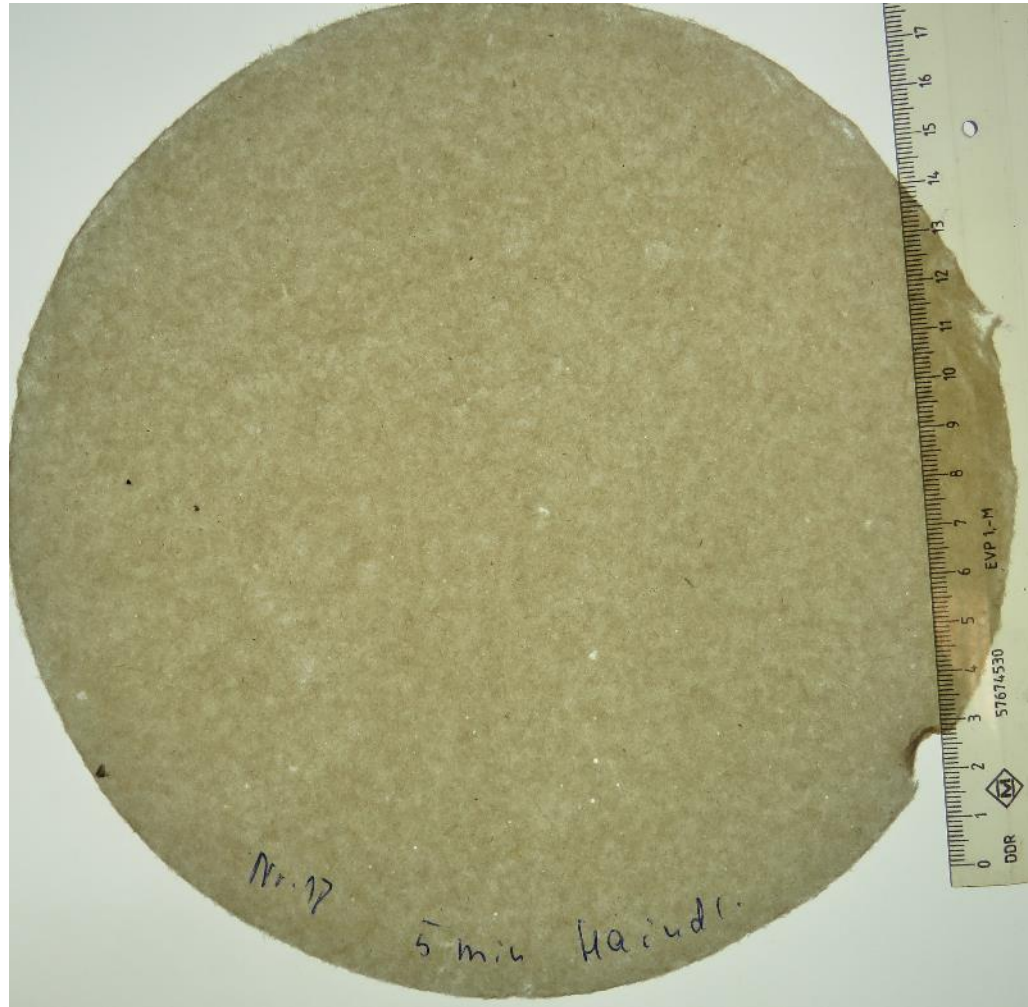


Residue of Haindl-Fractionation after 5 min disintegration – wet (Slotted plate 0,15 mm)



Visual appearance of dried pulp

with lab sheet after 5 min disintegration and after Haindl-Fractionation
(slotted plate 0,15 mm) - optical inhomogeneities - Transmitted light



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Aspects of Disintegration behaviour (1/3)

Material composition of the sample:

- The main component of the submitted sample is paper pulp.
- The sample is unprinted.

Disintegration behavior:

- The paper component could be largely disintegrated in 5 min.

Aspects of Disintegration behaviour (2/3)

Assessment of residues

- No coarse reject (vibration screen) was detected after 5 min, 10 min and 15 min disintegration time.
- Reject BRECHT-HOLL - Fractionation after 5 min, 10 min and 15 min disintegration time consists of fibre flakes.
- Total reject rate after 5 min disintegration was about 3 %. After 15 min disintegration the determined value was about 2 %.
- Compared to mixed recovered paper and board from households the reject rate of the investigated material after 5 min disintegration time is lower.

Solids content of the process water in the pulper (Filtration via paper filter with 12 µm)

- Concentration of dissolved and colloidal substances (solids) in the process water of the pulper after 5 min disintegration with a set solids content of 5 % total: 0.04 % solids content.
- The determined solids content is to be estimated as low.

Aspects of Disintegration behaviour (3/3)

Optical appearance of the disintegrated and screened pulp

- On lab sheets made from accept from the Haindl-slot fractionation (5 min disintegration time) no disturbing optical inhomogeneities are visible in the pulp.
- A large number of small round holes in the sheet structure were observed in the good stock sheets from slot screening. The cause of these defects and whether they occur and interfere with the paper manufacturing process is not yet known exactly. These defects are presumably caused by hydrophobic substances contained in the sample, which are used, for example, to hydrophobise the pulp or to achieve fat/water barriers.

Tackiness of the disintegrated and from the screened pulp (after 5 min disintegration)

- Lab sheets produced of the disintegrated, but not screened pulp (after disintegration, without Haindl slotted screening) showed no adhesive effect.
- Laboratory sheets of accepted stock from Haindl slotted screening show no adhesive effect.

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