



FIBRE based solutions

Recyclability of barrier papers

Wednesday 6th September 2023

Vienna

Specialty Papers Europe 2023



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PTS Research based in Heidenau



Papiertechnische Stiftung (PTS)



Transfer-oriented research institute



85
Employees



800 Seminar
Participants*



30 Research
Projects*
** Per year*



6,5 Mio. €
Turnover*



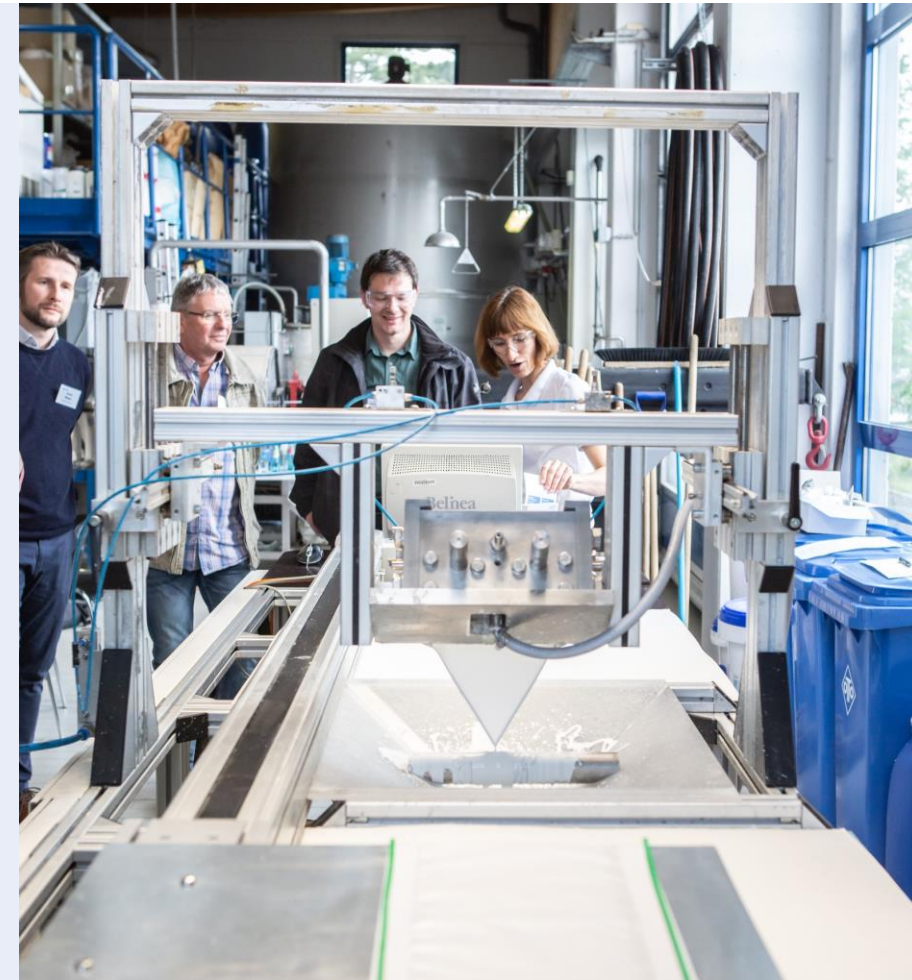
non-profit & neutral
Donators: FPT, HPV, DPI



Partner in
European Networks



500 Testing Methods
Accredited Laboratory





Smart & Circular Solutions



- Circularity of fibre based products, circular economy, recyclability
- Recovered paper management and processing
- Methods for quality management of (raw material, fibre stock and end product)
- Innovative measurement: PaperBaleSensor (PBS), DOMAS, RCP Monitor



Contact

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PfR Calculator

Recipe			
Grammage	1.02.00	1.04.01	1.11.00
g/m ²	100 %	0 %	0 %
Composition			
	Total	Detail	Index
Newspaper	0 %	0 %	21 %
Magazine	10 %	0 %	30 %
Advertising print	12 %	0 %	29 %
Other graphical paper	10 %	0 %	13 %
Corrugated board brown	25 %	50 %	0 %
Corrugated board white	10 %	35 %	2 %
Other packaging paper	10 %	10 %	5 %
Total	100 %	100 %	100 %
Calculate			
Initial Pulp Properties			
Schopper-Riegler	42	SR	
Ash Content (620°C)	20	%	
Bending Stiffness	0.339	Nmm	
SCF-index	3.095	Nmm/g	
Opacity	100	%	
Brightness (R487)	55	%	





FIBRE based solutions

Recyclability

- Recycling infrastructure
- Requirements of the paper industry



Recyclability

Recycling infrastructure for fibre-based packaging



collection



Recovered Paper – separate collection
Mixed lightweight packaging – comingled collection
Residual waste
Biowaste

sorting



No sorting
Deinking Sorting plant
Packaging sorting plant

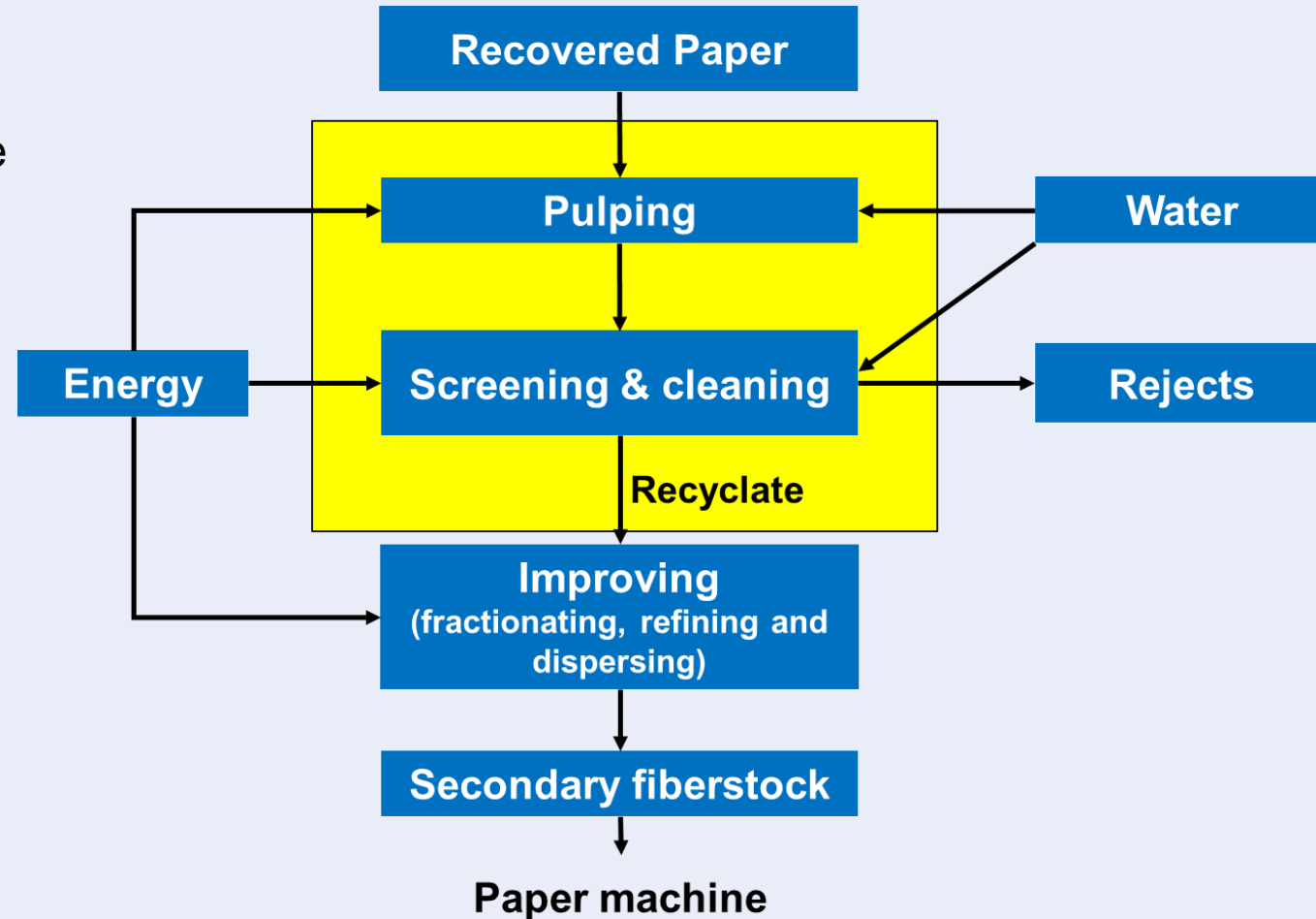
recovery



Standard recycling mill
Flotation deinking recycling mill
Recycling mill with specialized processes

Recycling requirements within paper industry

- **Quantity: recyclable content**
 - percentage of material that is available for the recycling
 - percentage of rejects
- **Quality: cleanliness of the recyclate**
 - Removability of impurities
 - Tacky and visual impurities
- **Effects on process performance**
 - Reject handling
 - Sticky deposits
 - Circular water and effluent qualities





FIBRE based solutions

**Cepi Recyclability
Laboratory Test Method,
version 2 (for recycling
in standard mills)**



Cepi Recyclability Laboratory Method, Version 2



Test method

Harmonised European laboratory test method to generate parameters enabling the assessment of the recyclability of paper and board products in **standard paper and board recycling mills**

Short title: CEPI recyclability laboratory test method Version 2, October 2022

[Cepi Recyclability Test Method Version 2 | www.cepi.org](http://www.cepi.org)

Annexes

- A) **Flowchart**
- B) Description of the **plate** for evaluation of the **coarse reject**
- C) Decision tree for the evaluation of the **visual appearance**
- D) Description of possible **Thickener**
- E) **Sheet adhesion test** reference pictures of the carrier board after sheet adhesions test
- F) Technical **data sheet**
- G) **Laboratory report** template
- H) **Detailed work description**

Cepi Recyclability Laboratory Method, Version 2



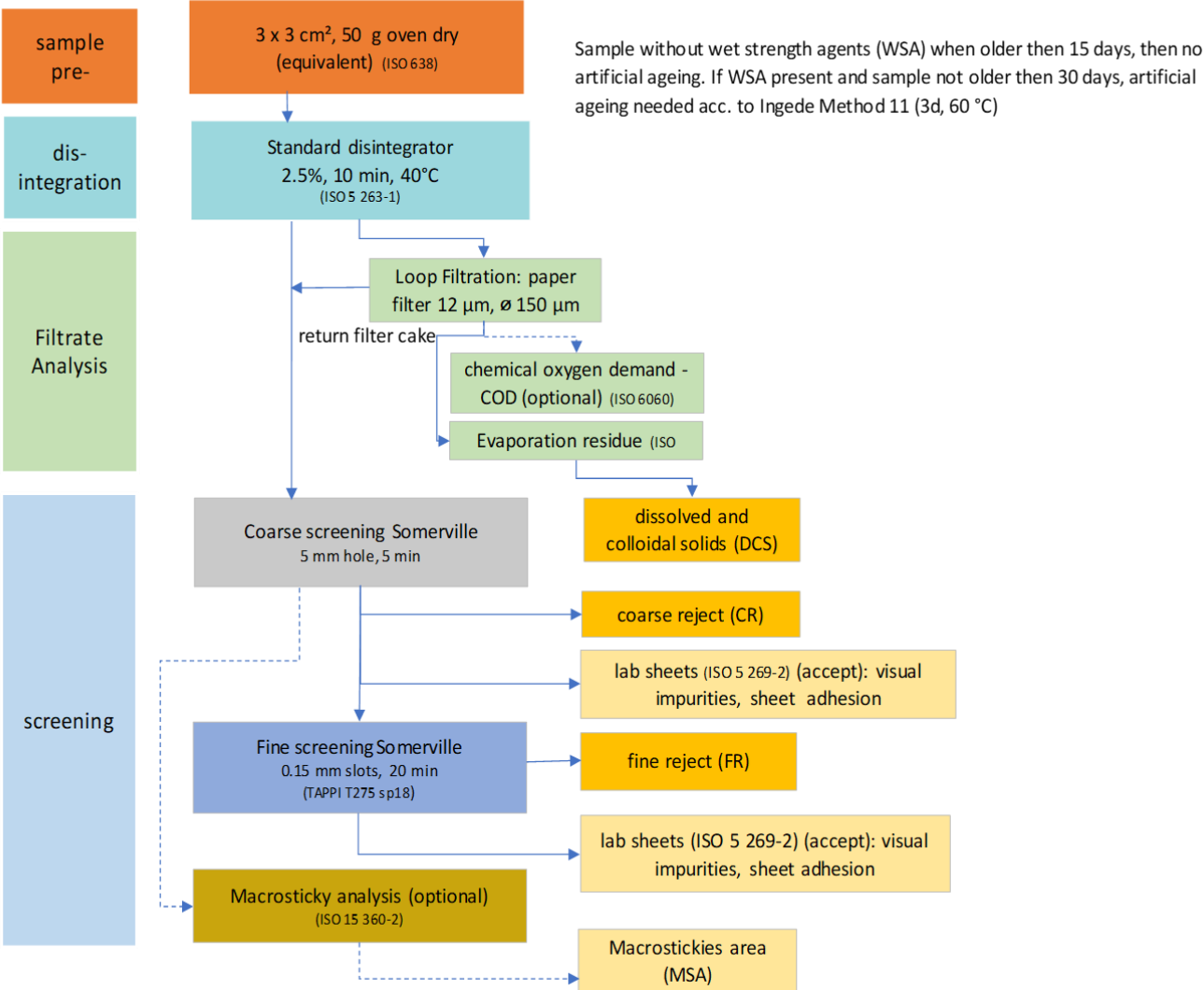
Test method steps

- Sample preparation
- Standard disintegration
- Filtration and filtrate analysis
- Coarse and fine screening
- Sheet formation
- Sheet adhesion test
- Visual impurities assessment
- Macrostickies analysis (optional)

Evaluation parameters

- Coarse reject CR
- Fine reject FR
- Total reject TR
- Reject quality RQ
- Dissolved and colloidal substances DCS
- Tacky impurities
 - Sheet adhesion test SA
 - Macrostickies area MSA (optional)
- Visual impurities VI

Cepi Recyclability Laboratory Test Method, Version 2



Cepi Recyclability Laboratory Test Method, Version 2



Disintegration

Standard disintegrator *ISO 5263-1*
10 minutes, 2.5 %, 40°C, pH 7-8



Pulp filtration

Loop Filtration
Buchner funnel 150 mm
Paper filter 12-15 µm



Filtrate analysis

Evaporation residue *ISO 638*
Chemical oxygen demand
COD (optional) *ISO 6060*



Dissolved and colloidal substances DCS

Cepi Recyclability Laboratory Test Method, Version 2



Coarse screening

Somerville fractionator *T275 sp18*
5 mm hole, 5 min



Coarse reject CR

Fine screening

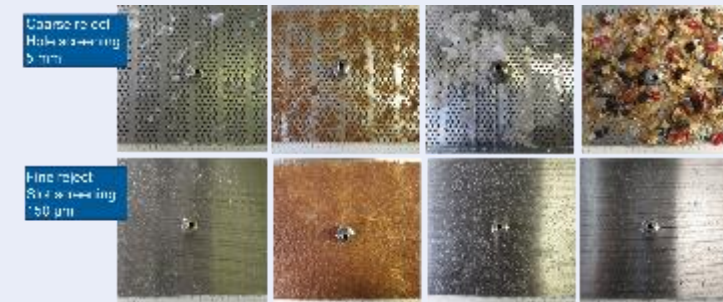
Somerville fractionator *T275 sp18*
150 µm slot, 20 min



Fine reject FR

Reject analysis

Photo documentation



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Reject quality RQ

Cepi Recyclability Laboratory Test Method, Version 2



Lab sheets

Rapid Koethen sheet former
ISO 5269-2

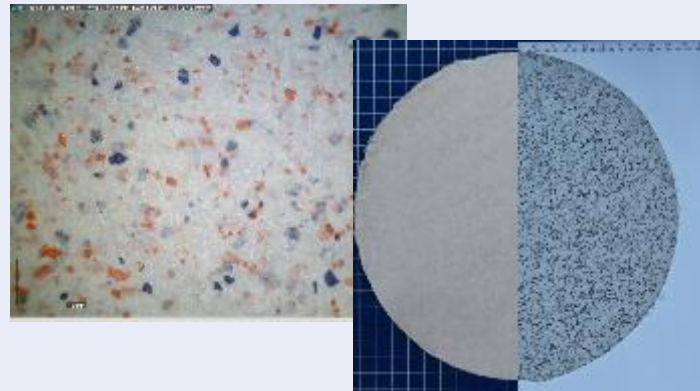


Visual impurities

Visual impurities: 4 levels

Assessment of

- Material
- Size
- Amount (per handsheet)



Visual impurities VI

Tacky impurities

Sheet adhesion: 3 levels

Macrostickies analysis
(optional) *ISO 15360*

Sheet adhesion SA



Macrostickies area MSA

Cepi Recyclability Laboratory Test Method, Version 2

Sheet adhesion SA



Level 1 - absent

Separation of lab sheet from carrier and cover does not show any defect



Level 2 – partly present

Clear fibre pull-outs on the surface of lab sheet, cover board and/or cover sheet



Level 3 - present

When separating from carrier and cover the lab sheet does not stay intact



Cepi Recyclability Laboratory Test Method, Version 2

Visual impurities VI

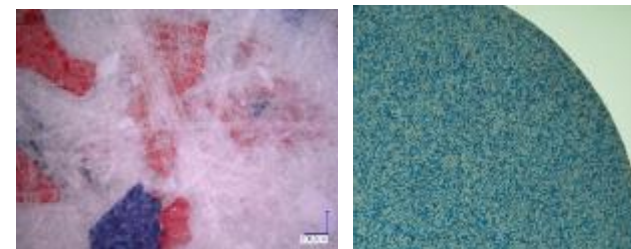
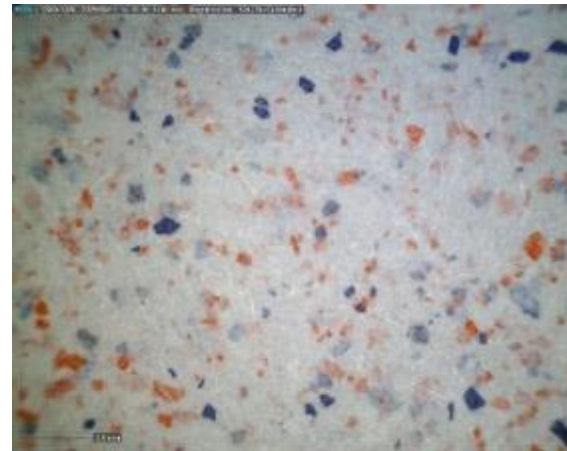
Metallised particles



Translucent particles



Ink-varnish particles



Pigment coating particles



Color shading



Cepi Recyclability Laboratory Test Method, Version 2

Visual impurities – decision tree table

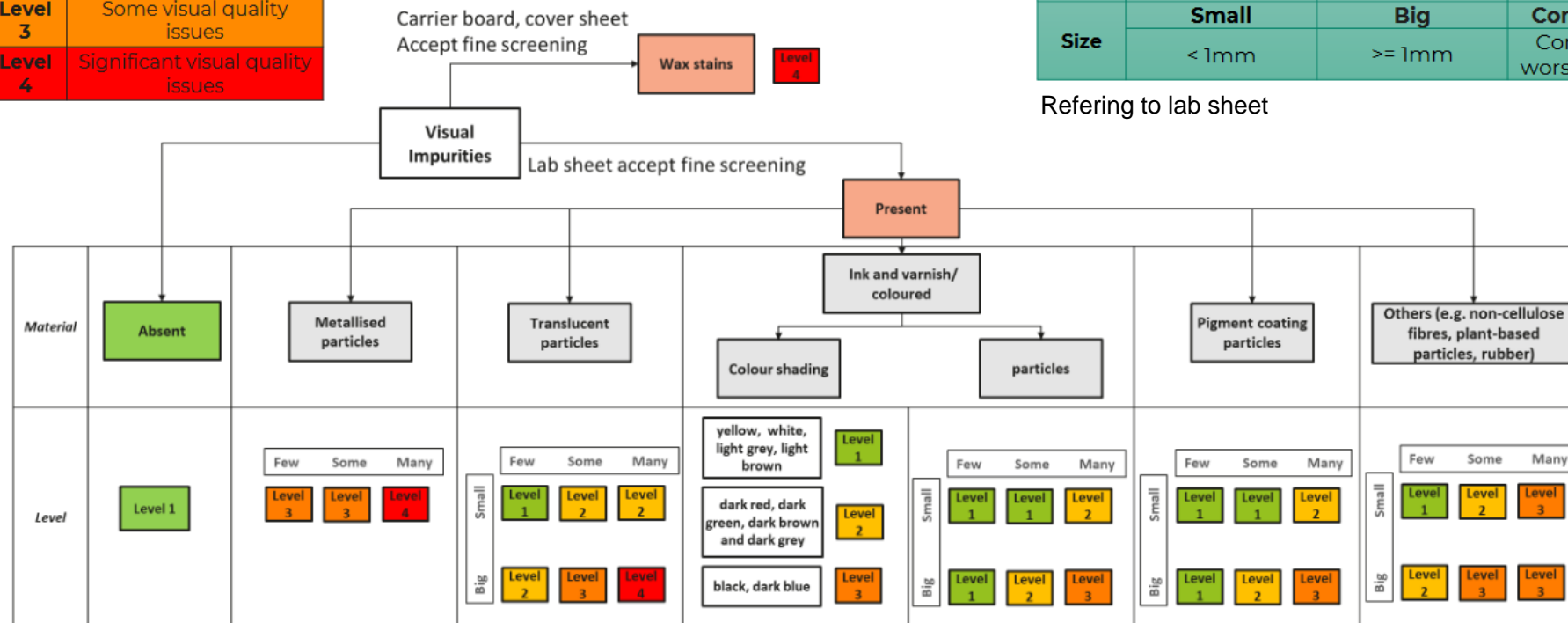


VI: Decision tree – table version (28-09-2022)

Level 1	No visual quality issues
Level 2	Minor visual quality issues
Level 3	Some visual quality issues
Level 4	Significant visual quality issues

Visual impurities			
Amount	Few	Some	Many
	< 10	10 – 100	> 100
Size	Small	Big	Combination
	< 1mm	>= 1mm	Consider the worst case level

Referring to lab sheet



NOTE: All applicable columns should be evaluated. Worst case level allocation applies.

Cepi Recyclability Laboratory Method, Version 2

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[guidelines and protocol - 4evergreen](https://www.4evergreenforum.eu/guidelines-and-protocol)
[4evergreenforum.eu](https://www.4evergreenforum.eu)

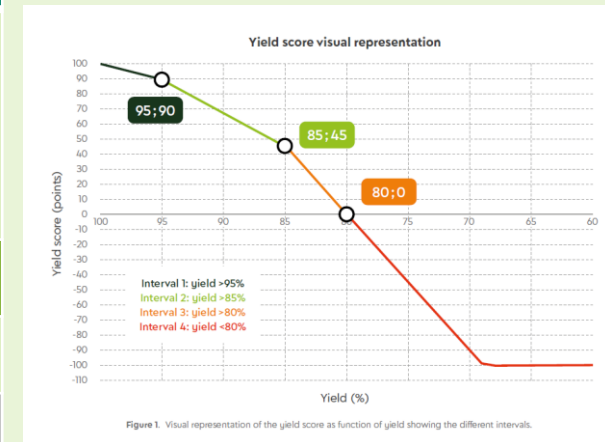
Beta version

Later version

4evergreen recyclability evaluation protocol

Part I standard mill recycling – beta version Dec 2022

Parameter	Evaluation	Score
Coarse reject CR	Yield	<0 to 100 points
Fine reject FR		
Total reject TR		
Sheet adhesion SA	3 Levels	0 or KO
Visual impurities VI	4 Levels	0 to -30 points
<i>Reject quality RQ</i>	NA	NA
<i>Macrostickies MSA</i>	NA	NA
<i>Dissolved and colloidal substances DCS</i>	NA	NA



total score	description
0-100	Suitable for Standard Mill recycling
< 0*	Not suitable for Standard Mill recycling. Potentially recyclable in other mill types



FIBRE based solutions

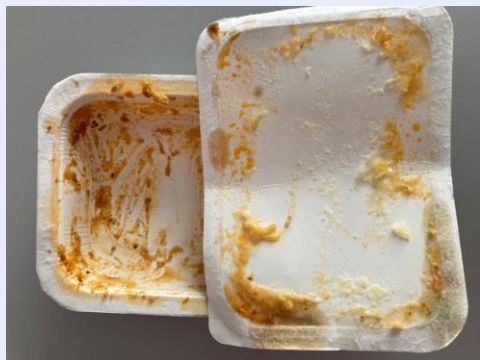
Challenges in recyclability of barrier papers



Challenges in recyclability of barrier papers

What happens with the barrier paper after usage?

- Is it contaminated in a way that material recycling is not suitable?
- Is it collected into a recycling stream?
- Is it sorted into the correct secondary material stream?
- Are the fibres recovered in a paper recycling mill?



What happens with the barrier during recycling?

- Does it allow the water to contact the fibres?
- Does it fragmentate into large pieces that could be removed into the reject stream?
- Does it fragmentate into particles which will stay in the water phase as dissolved and colloidal solids?
- Does it fragmentate into particles which will stay attached to fibres and might end somewhere in in the final paper?
- Does it cause tacky particles?

Answer: „It depends“

Does the barrier allow the water to contact the fibres?

- Pulping behaviour depends on how well water can access fibres
- Pulping needs longer time for double-sided coated materials, as water can only soak from cutting edges, therefore in standard recycling processes these materials usually end up completely in the reject stream



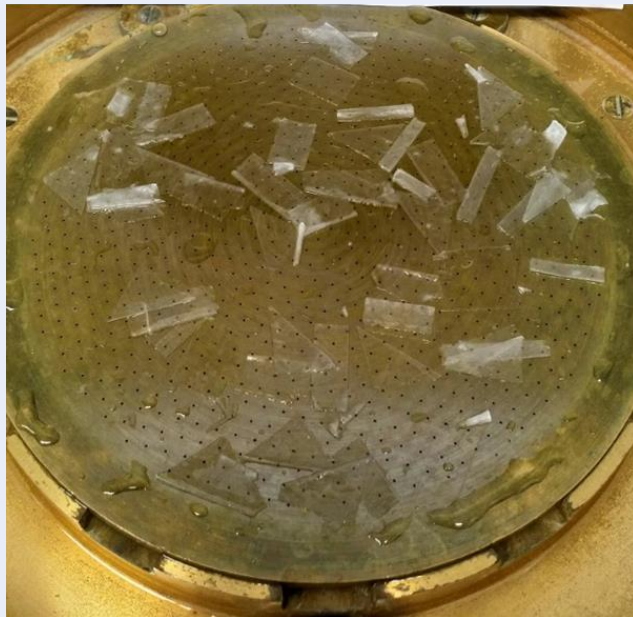
Reject of double-sided PE-coated board after 20 min pulping



Reject of one-side PE-coated board after 20 min pulping

Does the barrier fragmentate into large pieces that could be removed into the reject stream?

- Fragmentation behaviour of coating during pulping determines if it can be separated during screening process or remains in secondary fibre stock (recyclate)



Reject of different barrier papers after 20 min disintegration (PTS-RH 021 method, 0.7 mm hole)

Does the barrier fragmentate into particles which will stay in the water phase as dissolved and colloidal solids?

- Barriers with low shear and water resistance might form dissolved and colloidal substances in the filtrate (water phase), staying in the system with circular process water

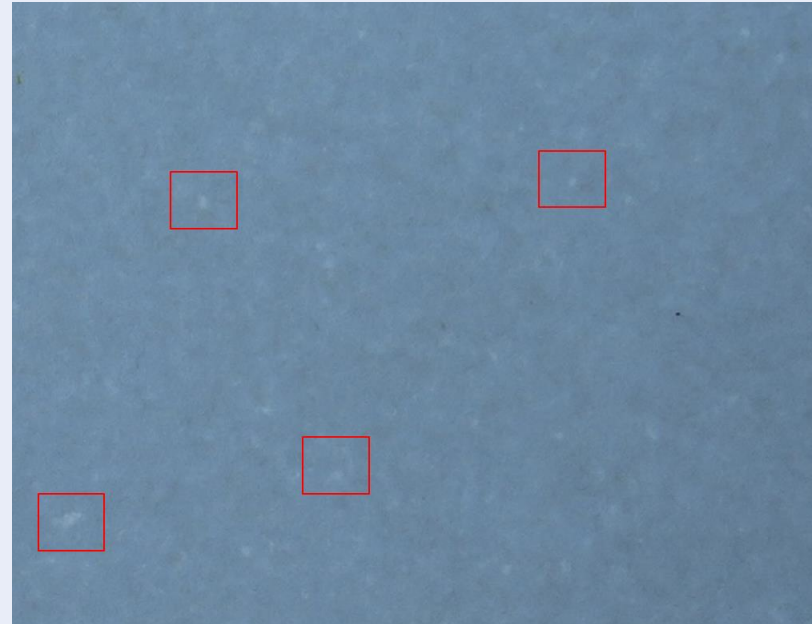
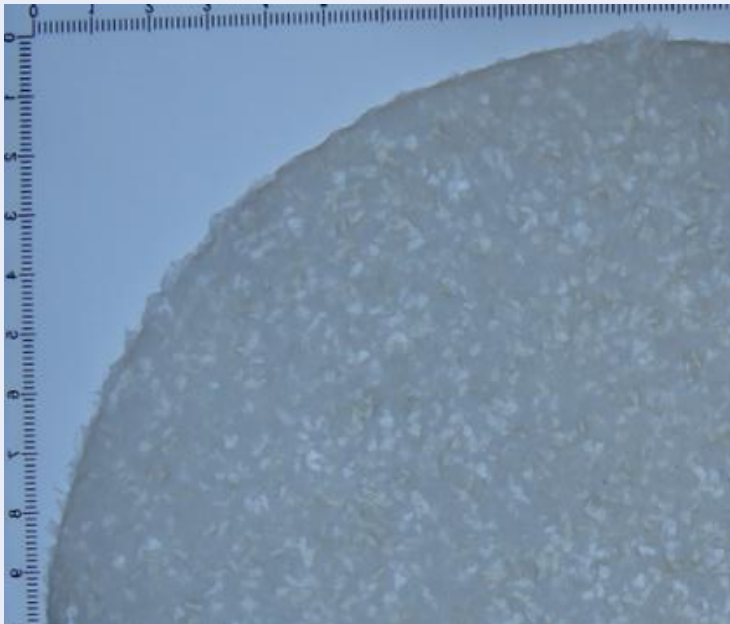


Gravimetric evaporation residue (filtrate acc. to Capi recyclability lab test method, V2)

Reference Samples	Gravimetric Residue [mg/g fibres]	COD [mg O ₂ /g fibres]
Bleached chemical pulp	4	3
Corrugated substrate 100 % recycled	2	17
Corrugated cardboard (single wall board)	41	42
Corrugated cardboard (double wall board)	55	50
Dispersion coated paper (Alginate, one side)	144	137
Dispersion coated paper (one side)	74	131

Does the barrier fragmentate into particles which will stay attached to pulp

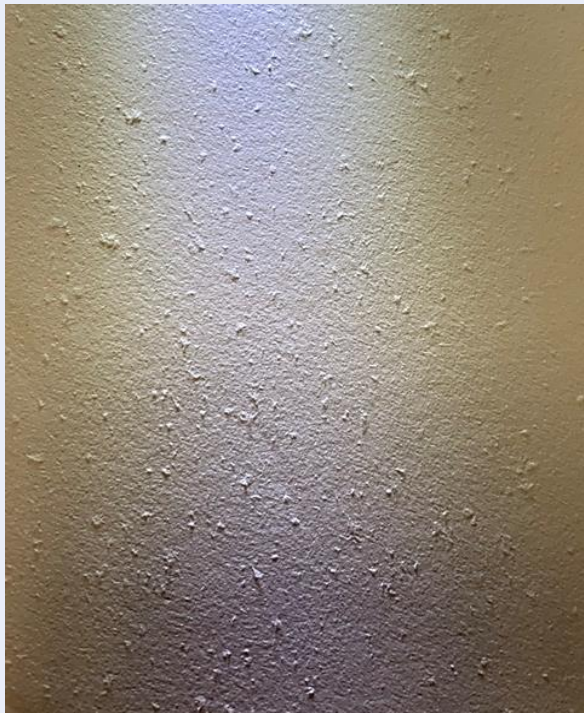
- Large pieces of coating can be separated easier in screening steps, whereas small particles of coating are ending up in recyclate, hence decreasing product quality or causing deposits in the process equipment



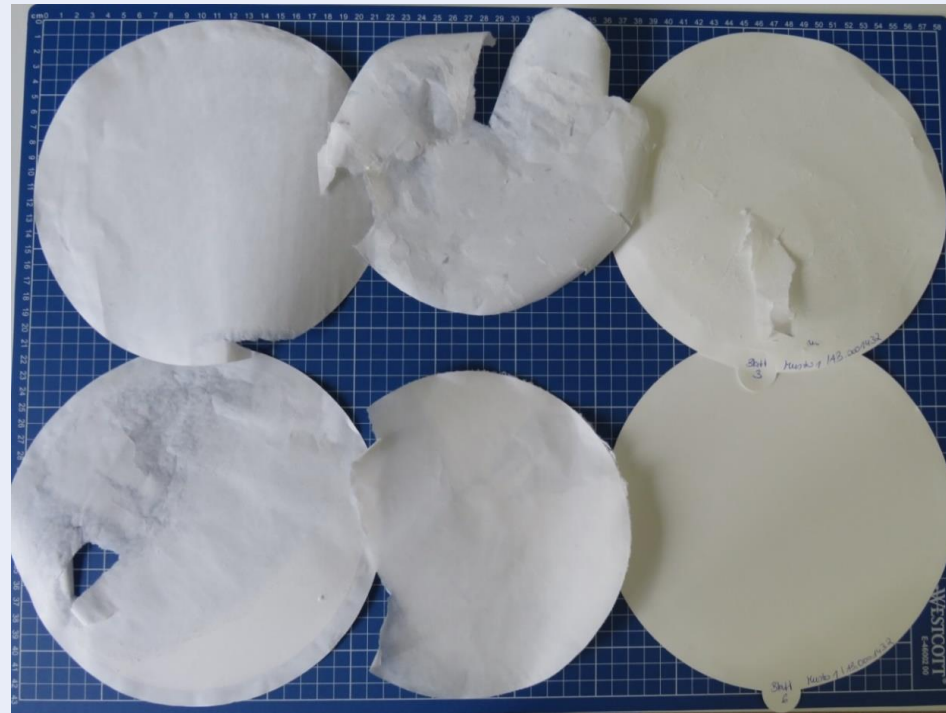
fragmented coating particles in transmitted light (accepts material acc. to Capi recyclability lab test method, V2)

Does the barrier cause tacky particles?

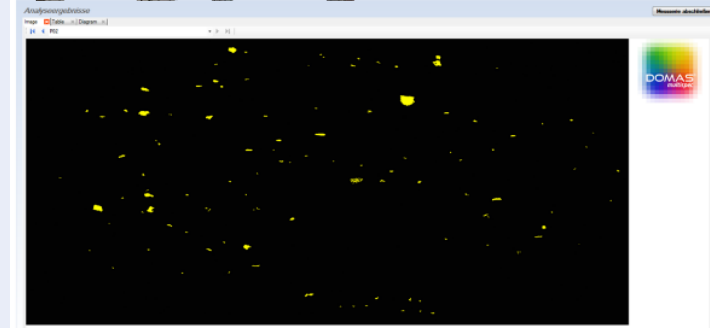
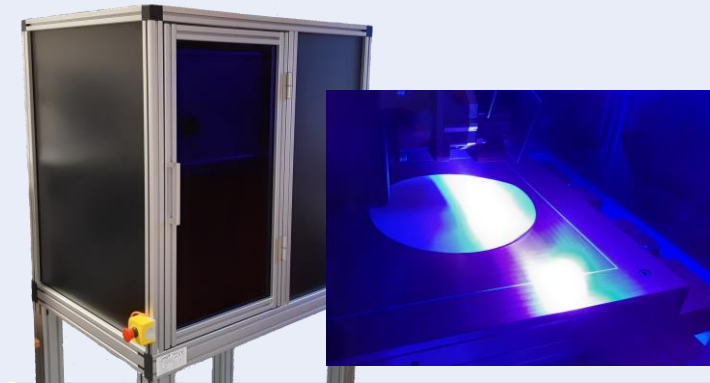
- Barrier polymers or adhesives might cause tacky particles



sheet adhesion
partly present (Level 2)



sheet adhesion
present (Level 3)



Polymer particles detection
with NIR imaging

Thank you!



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PTS Conference „PTS Coating Symposium 2023 “ 13. & 14. September Bamberg
PTS Workshop „Recyclability of paper & board based packaging“ 21. & 22. September online