



SIMPLICITY CHASERS

2024

Bridging the Gap: Current PVB Recycling Challenges and Knowledge Needs for Laminated Glass Applications



Simplicity in Sustainability



Content

- Key Drivers For r-PVB and Value Preservation
- **Key Challenges**
- **Speaking the same as the end customer**
- **Closing Message**



R-PVB has 80% CO₂ emission reduction potential



- The current mechanical technologies employed **do not adequately purify PVB films**, resulting in limited purity levels.
- Consequently, recycled PVB has primarily been restricted to **low-quality applications**, including tiles, carpets, paints, sound insulation, and as a filler in bitumen.



-75%

Value kill

4 €

Value of 1kg virgin PVB sheet

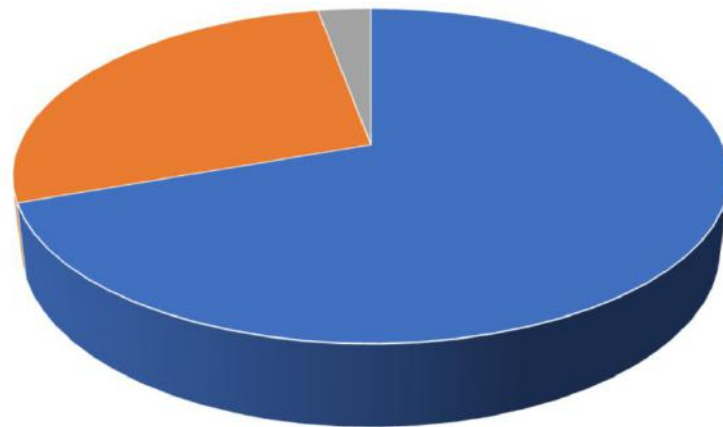
1 €

1kg r-PVB value in low
quality applications

Excluding last years price hikes which have been fading away ...



Composition Breakdown of PVB Film



- PVB Resin
- Plasticizers
- Stabilizers & Additives

What is the composition of the r-PVB after recycling process?



Utilizing recycled PVB (R-PVB) in interlayer films is the sole avenue to facilitate **increased recycling volumes** while safeguarding its **intrinsic value**



Key Challenges

1. Strong Adhesion to Glass

1. *Issue:* Tightly bonded interlayer resists separation.
2. *Impact:* Hard to extract pure PVB without damage.

2. Contamination Removal

1. *Issue:* Embedded glass particles, adhesives, and chemical residues.
2. *Impact:* Requires intensive cleaning processes, raising costs.

3. Material Degradation

1. *Issue:* Aging and environmental exposure reduce PVB quality.
2. *Impact:* Limits usability in high-quality applications.

4. Economic Viability

1. *Issue:* High processing costs for variable-quality output.
2. *Impact:* Recycled PVB struggles to compete with virgin material.

R-PVB MECHANICAL RECYCLING PROCESS STEPS



1

BREAKING MODULE

S-shape breakers are best fit to result in larger pieces of PVB flakes which are best fit for later washing step.

2

STRIPPER MODULE

Same principle as breaking module but with finer pitch to remove up to 60% of glass from PVB.

3

FRictionAL RUBBING

Continuous frictional rubbing line removing additional 30% of glass from PVB surface

4

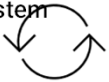
FLOATING LINE

Removing Glass dust from PVB surface resulting in removal of 5% from PVB surface (air floater preferred vs sink floating)

5

WASHING LINE

3 step washing line with ionic media to have a high purity PVB flakes (less than 1% of glass) + dewatering system



6

HOT AIR DRYER

Additional dryer to lower overall water content. (Required if PVB flakes are to be used directly in a PVB sheet extruder. Can be present at PVB commercial line)

7

EXTRUDER

Twin screw extruder to control recycled PVB quality & screen-filters mechanical contamination

8

PELLETIZER

Standard plastic pelletizer installed at exit of extruder

<0,5%

Contamination

Still too many and too large particles present

SPEAKING THE SAME LANGUAGE: R-PVB SHEET FOR LAMINATED GLASS



INPUT

YELLOW INDEX

PVB which is exposed to increased temperatures (multiple extrusions)

- Monolayer applications such as automotive are more accepting
- Architectural Applications are more sensitive

CONTAMINATION LEVEL & TYPE

A mechanical particle of a size $>75\mu\text{m}$ can create bubble defect in multilayer applications (acoustic films or multi-layer setup)

- Can the PVB manufacturer filter this out during extrusion?

HAZE

Acoustic, white (colored) PVB, contamination of any kind, etc... results in light scattering

- What haze levels are acceptable?

FLOW

Flow properties defining autoclaving cycles at laminators & extrusion process

ADHESION

r-PVB needs to be compensated for adhesion and water content

ROUGHNESS

R-PVB needs to be compensated for roughness

AO & UV PACKAGE

AO (anti-oxydants) & UV Package needs to be adjusted

PLASTICIZER

Plasticize is typically lost during mechanical cleaning and requires compensation



"Many recyclers understandably emphasize **cleanliness** as an important attribute of their recycled PVB products. However, by **defining quality through a broader set of standards**, we can help recycled PVB meet a wider range of application requirements and ensure that it consistently performs to high standards. Incorporating specifications such as optical and mechanical properties can enhance the material's market potential and foster **greater alignment with end-user needs.**"



What R-PVB Specification?

Property	Unit	PVB sheet Virgin	r-PVB
Yellow Index		<1	?
Refractive Index (23°C)		1,5	?
Haze	%	<1	?
Glass Temperature	°C	25°C	?
Moisture	%	0,4	?
Plasticizer	PHR	35	?
Residual contamination >100µm	Count (25x25cm)	0	?
FTIR overlap	%	100%	?



Moving Toward Holistic Quality Standards for r-PVB

Key Takeaways:

- **Cleanliness as a Foundation:** Cleanliness remains essential but is only one part of the quality spectrum.
- **Broadening Specifications:** Introducing additional criteria like optical and mechanical properties and consistency ensures r-PVB meets a wider range of high-end applications.
- **Value for End Users and Market Growth:** Holistic standards position r-PVB as a premium, reliable alternative for virgin PVB .
- **Our Shared Goal:** Let's work together to expand and define robust quality metrics, strengthening the industry and aligning with end-user needs.



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Over 22y leadership experience
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Empowering Talent
Making things happen
Problem Solving



Simplicity in Sustainability



“My passion lies in solving complex challenges and creating pathways to a sustainable future. Every solution is a step toward making sustainability practical, impactful, and achievable for all.”

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