The journey continues

Markus Schönfeld

Sept 23rd, 2026

- PVC free sustainable primary packaging for solid oral forms -

4. Symposium – Pharma Verpackung

Neuhausen am Rheinfall

NOVARTIS

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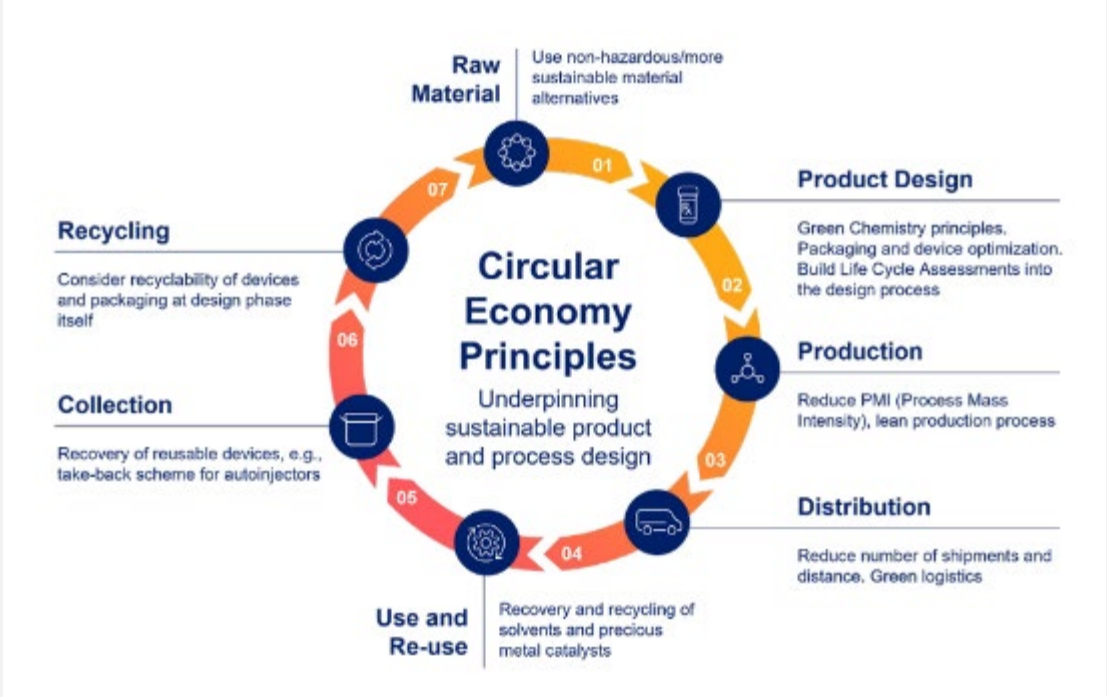
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Focus on nature and circular economy principles

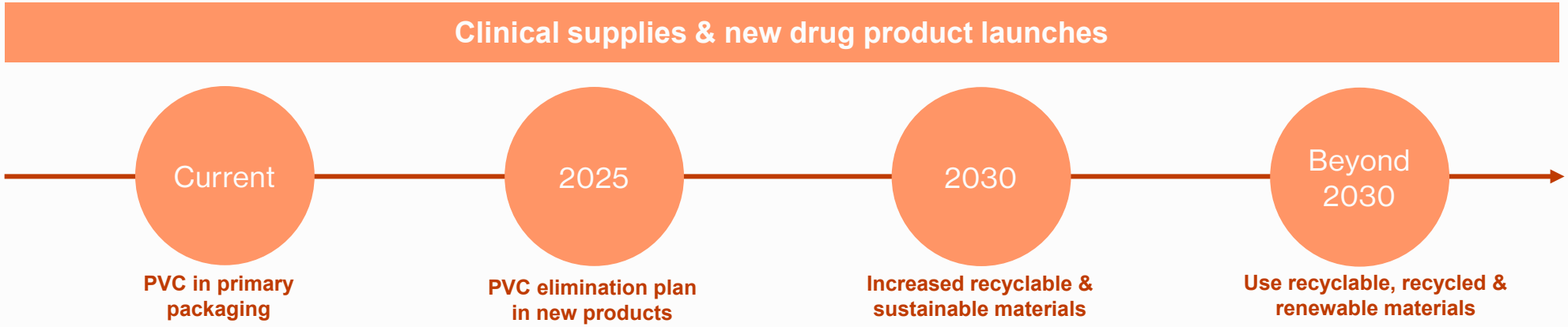
Water use	Implement water use reduction for own and supplier sites based in water stressed basins.
Water pollution	Ensure no water quality impacts from manufacturing effluents from our own manufacturing sites and high-risk suppliers by 2025. This target has been complemented by a target for 2030 that extends our scope to include our own labs and all active pharmaceutical ingredients (API) suppliers.
Waste	Reduce the amount of waste sent for disposal in our core operations by 50% by 2025 (vs. 2016 baseline), and a further 30% by 2030 (vs. 2022 baseline)[2]. In addition, we will eliminate the use of polyvinyl chloride (PVC) in our packaging by 2025.[3]
Biodiversity and raw materials	Assess the impact on nature at Novartis sites close to nature-sensitive areas and, where material, establish site-specific biodiversity management plans. In addition, implement a sustainable sourcing program, starting with a pilot in 2025.

[1] Definition of Nature Positive: 'Halting and reversing nature loss by 2030 and achieving full recovery by 2050'.
[2] Additionally, we retired our previous target of achieving "plastic neutrality by 2030" and are evaluating potential new targets as our plastic footprint has significantly decreased following the Sandoz spinoff in 2023.
[3] Defined as secondary and tertiary packaging for our own final product packaging sites, primary packaging when feasible.



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PVC free / sustainable primary packaging
Strategy for oral solid forms[1]



[1] PVC free strategy endorsed on May 2023
[2] Instead of PVC based polymer blisters until adequate mono polymer blisters are available
[3] mono PP endorsed as successor of PVC-AL blisters on Jan'2025

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PVC free sustainable primary packaging
Future options to replace current packaging[1]

New

	Blister					Strippack	HDPE bottle		Stickpack, sachet	
Current packaging	PVC-AL	Duplex90-AL	Triplex-AL/ Aclar-AL		Alu-alu (PVC)	Not available at Novartis	Alu liner / Induction seal		PET/AL20/PE	
Moisture barrier	Low	Medium	High		Ultra-high		High		Ultra-high	
										No potential replacement
Moisture barrier	Low	Medium	High	High – ultra high	Ultra-high	Medium - High	Medium	High	Medium - high	Ultra-high
Sustainable alternatives	PET, **PP** & (PE)	PE, (PP) & PP/COC/PP*	None	Overwrapping sust. medium barrier blisters	**Alu-alu (PE)**	Metallized PP, metallized PO*	Lightweighted, PE liner	PE liner	Metallized PP, metallized PO*	None
Comments	PET might not maintain the shelf life of all products being packed into PVC		Polymer solution to replace Triplex 180 & Aclar4000 blisters likely not reachable	Foils as for strippacks: Metallized PP, Metallized PE, metallized PO*	Shelf life extension of medicine might be feasible vs medicine packed in current material	Tablet section size to check / could be to small for being sortable	Alu free liner, mechanical seal	Alu free liner. Mechanical seal & propectively may be thermo seal		Polymer solution not feasible

* Might not meet the future Design for Recycling (DfR) criteria of EU Packaging & Packaging Waste Regulation (PPWR)

Bold blue - Endorsed

→ Change complies with the current strategy of Novartis

- - - → Adds a new packaging type and/or element

[1] Status of today based on data generated by Novartis

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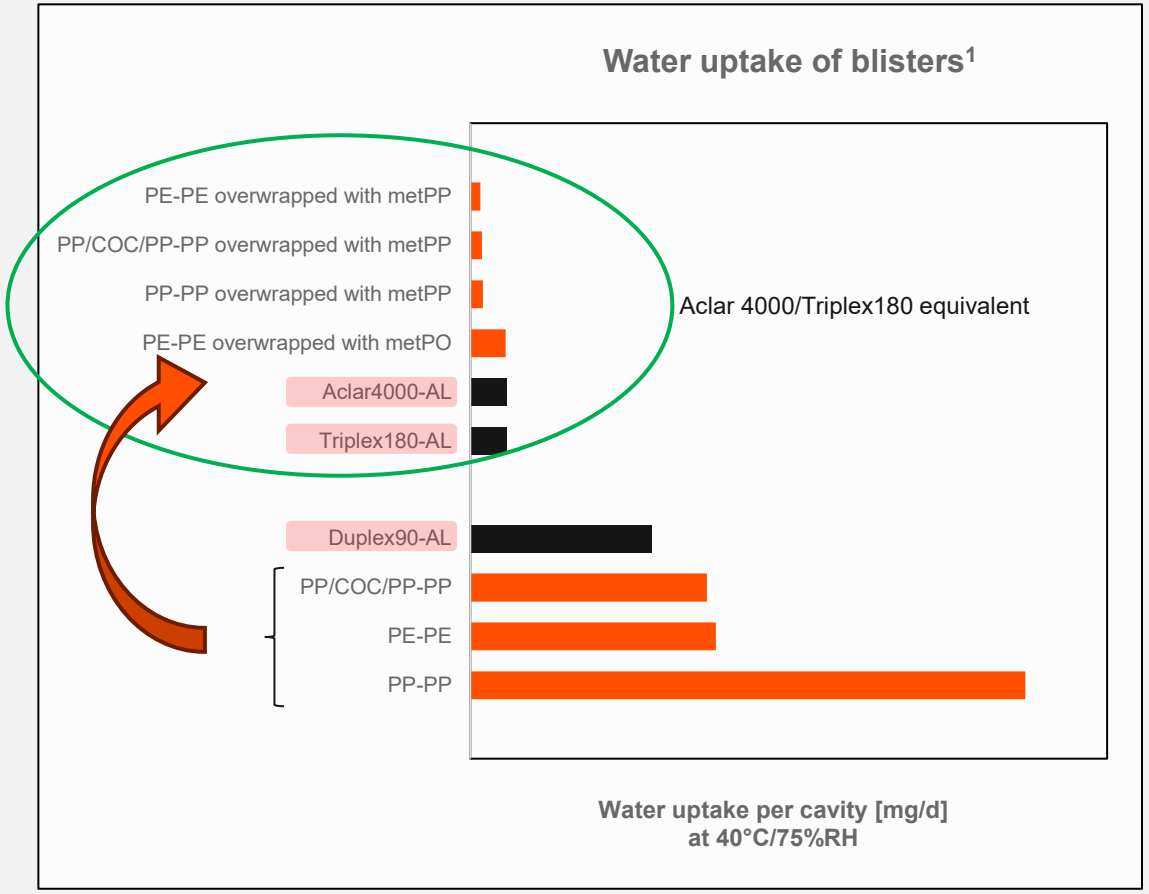
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Overwrapped mono polymer blisters

An alternative to Triplex & Aclar



Configuration:
3 blister cards per pouch



[1] Data generated by Novartis

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Packaging examples & challenges

- PVC free alu alu blisters
- Mono polymer blisters

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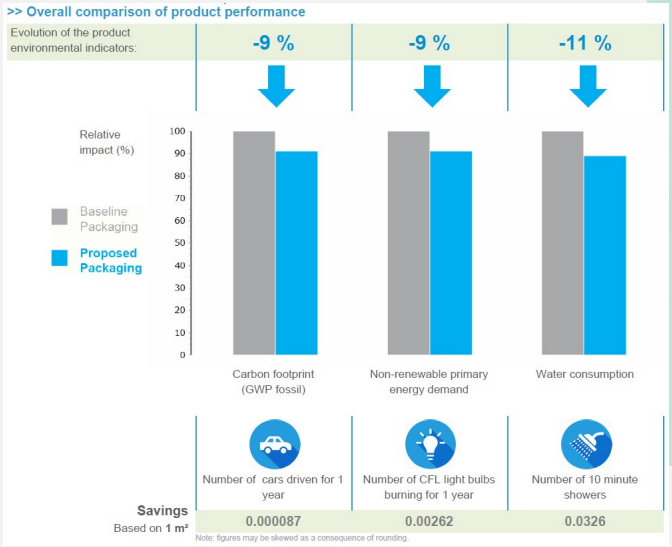
PVC free alu alu blister
push through

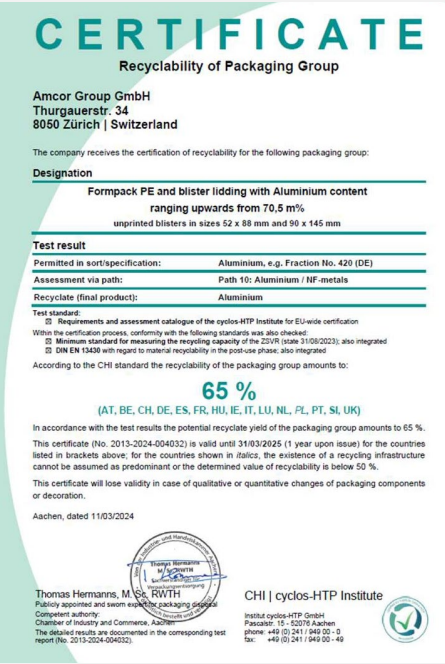
PFAS & BPA free

		Current		Proposed	
Base	OPA	25 µm		OPA	25 µm
	AL	45/47 µm		AL	47/50 µm
	PVC	60 µm		PE	40 µm
Lid	ALU	20 µm		ALU	20 µm
	HSL*	7 g/m²		HSL[1]	3.5 g/m²
Grammage total		299 g/m²			272.2 g/m²
Grammage reduction					9%

Contains ~70% ALU (AL recycling stream)

* HSL: Heat Seal Lacquer




CERTIFICATE

Recyclability of Packaging Group

Amcor Group GmbH
Thurgauerstr. 34
8050 Zürich | Switzerland

The company receives the certification of recyclability for the following packaging group:

Designation

Formpack PE and blister lidding with Aluminium content ranging upwards from 70,5 m%
unprinted blisters in sizes 52 x 88 mm and 90 x 145 mm

Test result

Permitted in sort/specification:	Aluminium, e.g. Fraction No. 420 (DE)
Assessment via path:	Path 10: Aluminium / NF-metals
Recyclate (final product):	Aluminium

Test standard:
☒ Requirements and assessment catalogue of the cyclos-HTP Institute for EU-wide certification
Within the certification process, conformity with the following standards was also checked:
☒ Minimum standard for measuring the recycling capacity of the ZSVR (state 31/08/2023); also integrated
☒ DIN EN 13430 with regard to material recyclability in the post-use phase; also integrated

According to the CHI standard the recyclability of the packaging group amounts to:

65 %
(AT, BE, CH, DE, ES, FR, HU, IE, IT, LU, NL, PL, PT, SI, UK)

In accordance with the test results the potential recyclate yield of the packaging group amounts to 65 %.

This certificate (No. 2013-2024-004032) is valid until 31/03/2025 (1 year upon issue) for the countries listed in brackets above; for the countries shown in *italics*, the existence of a recycling infrastructure cannot be assumed as predominant or the determined value of recyclability is below 50 %.

This certificate will lose validity in case of qualitative or quantitative changes of packaging components or decoration.

Aachen, dated 11/03/2024

Thomas Hermanns, M.Sc. RWTH
Publicly appointed and sworn expert for packaging disposal
Competent authority:
Chamber of Industry and Commerce, Aachen
The detailed results are documented in the corresponding test report (No. 2013-2024-004032).

CHI | cyclos-HTP Institute
Institut cyclos-HTP GmbH
Postcode: 15 - 52076 Aachen
phone: +49 (0) 241 / 949 00 - 0
fax: +49 (0) 241 / 949 00 - 49

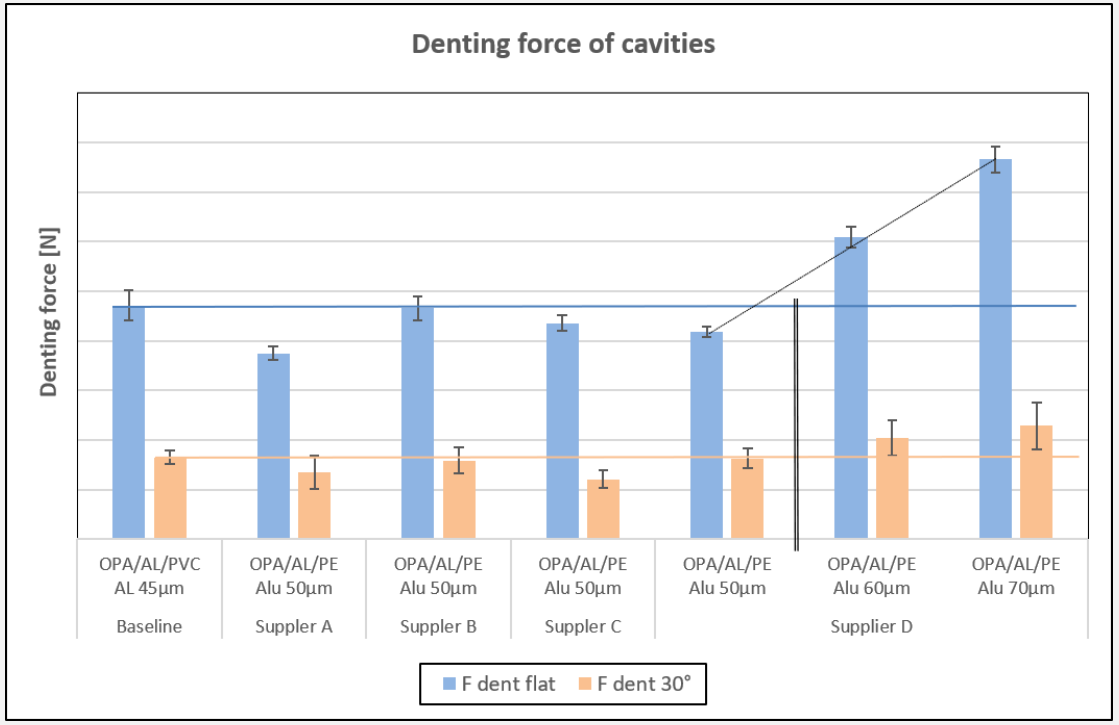
Cradle to Grave. End life scenario considered in above data: 100% mechanical recycling of alu, incineration of the remaining materials with energy recovery

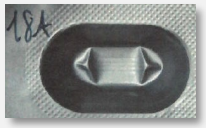
Source: Amcor Flexibles Kreuzlingen AG, LCA Assessment report n°19811 dated on Aug 31st, 2026

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PVC free alu alu blister
Mechanical properties





F_{dent} flat



F_{dent} 30°

OPA/AL50/PE softer than OPA/AL45/PVC

Risk of processing failures but also dents during product transportation

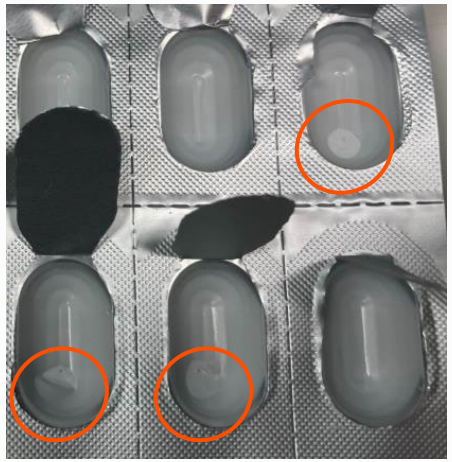
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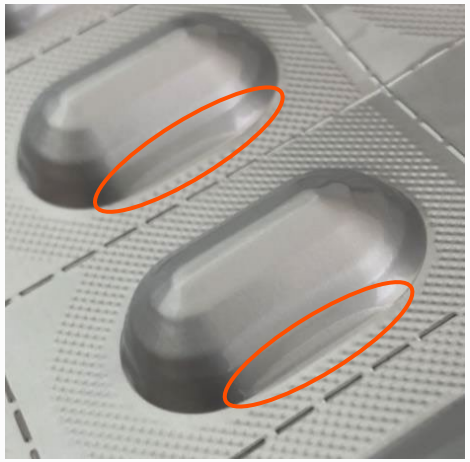
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PVC free alu alu blister
Material stability

Minimum requirement:

No delamination up to product shelf life of 36m at 30°C/75%RH





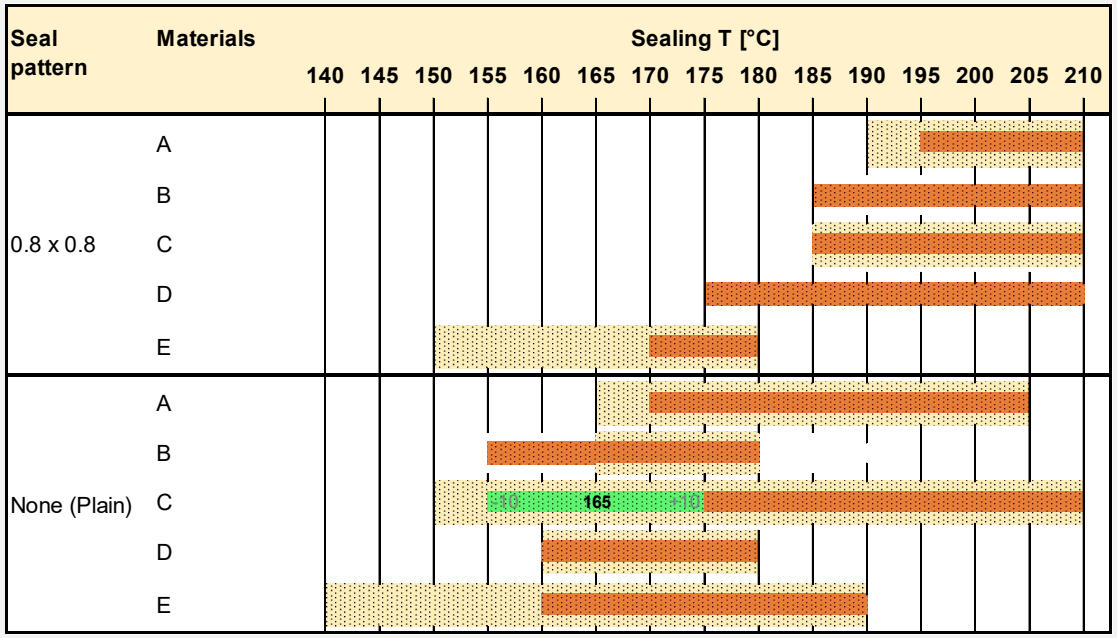
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PVC free alu alu blisters
Processing challenges

Test results of initial material specifications

Example: Sealing on Klöckner CP3 (plate sealing) at 45 str/min





Expected seal quality
No «halo»



Pronounced
«halo»

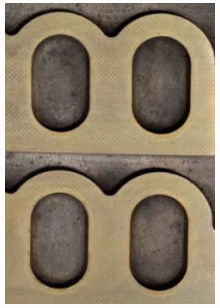


Extreme
«halo»

Processing of blisters not adequately feasible; materials to improve



0.8 x 0.8



Plain

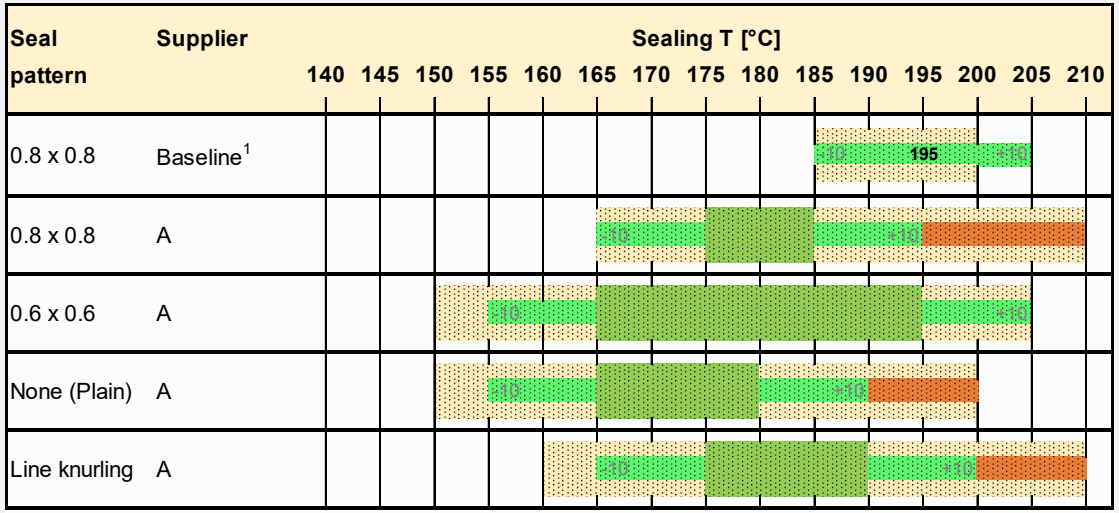
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PVC free alu alu bliser
Processing challenges

Improved materials:
Expected process quality

Example: Supplier A, Klöckner CP3 (plate sealing) at 45 str/min



[1]OPA/AL/PVC 25/45/60 - AL20

Tightly sealed blisters
Seal range
Peel off / halo effect

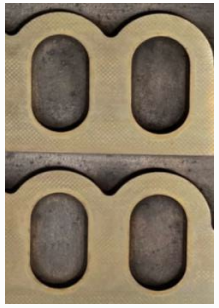
Sealing behavior depends on the material, seal principle, tooling design & the machine type



0.8 x 0 .8



0.6 x 0.6



Plain

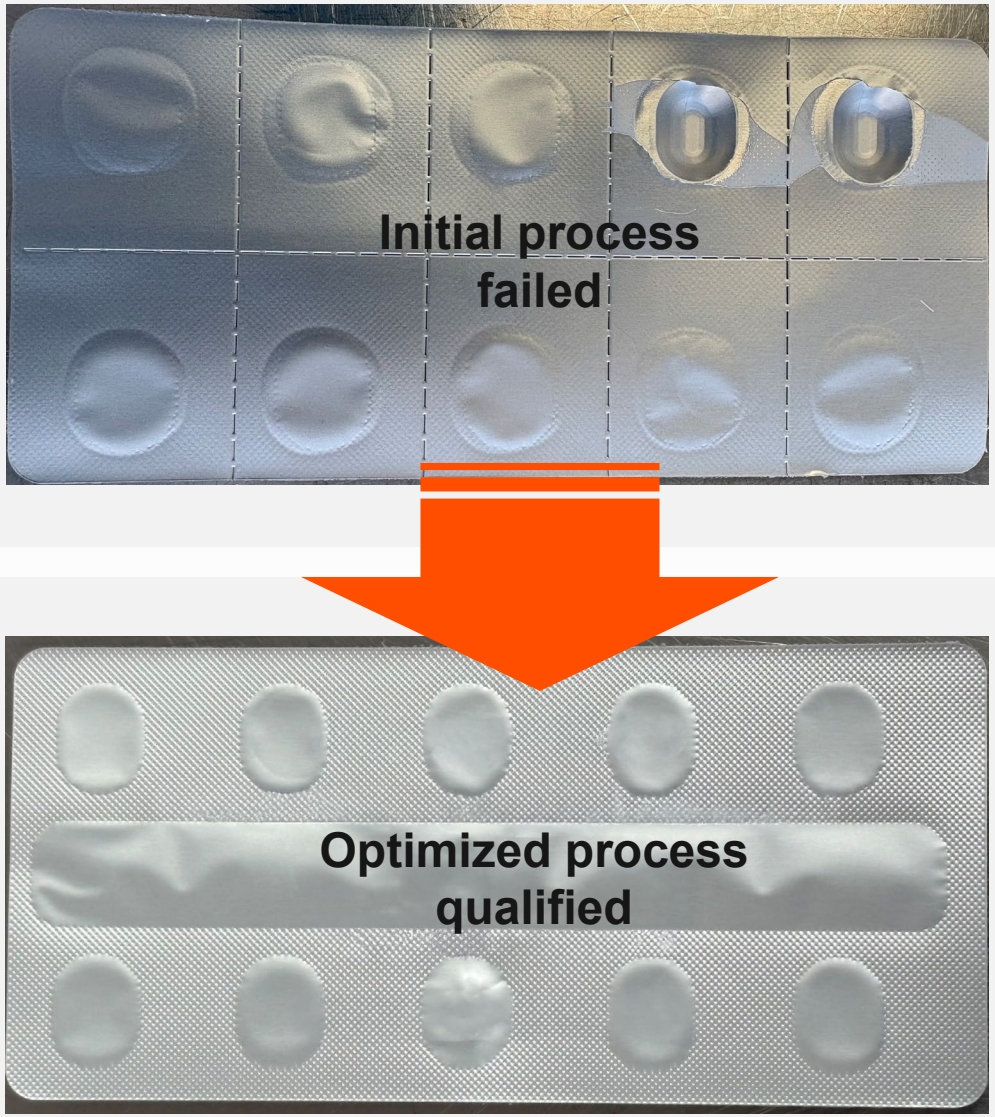


Line knurling

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PVC free alu alu blisters
Processing challenges



Use of well performing materials on another machine may result in process challenges

Example: Supplier A on Noack DPN 760

Seal pattern	Machine / Speed	Sealing T [°C] 160 170 180 190 200 210 220 230 240
0.8 x 0.8	Noack DPN 760 20 str/min	≥10 ≥10
0.8 x 0.8	**For comparison** Kloeckner CP3 45 str/min	≥10 ≥10

Tightly sealed blisters
Seal range
Peel off / halo effect

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Packaging examples & challenges

- PVC free alu alu blisters
- Mono polymer blisters

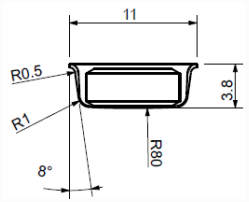
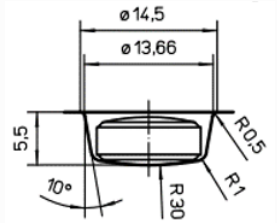
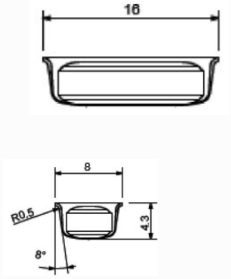
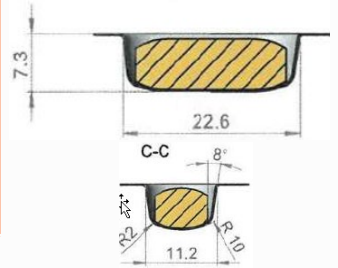
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Mono polymer blister
Setup for testing

Materials & machines:

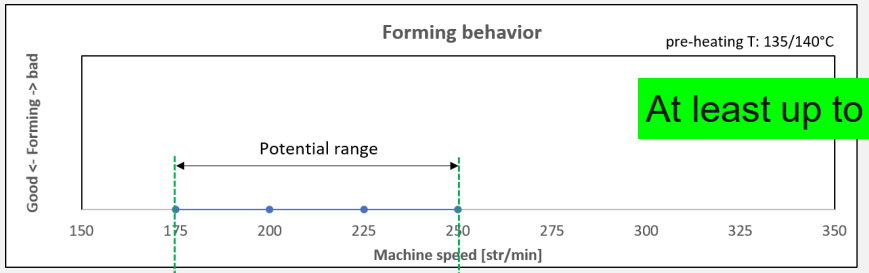
- Materials:
  - PET, PP, PP/COC/PP & PE
- Machines
  - Plate sealing:
    - Kloeckner CP3 & CP8
    - Uhlmann USP1030
  - Rotary sealing
    - Noack N921
    - IMA Giant1
    - IMA C90

Cavities	Smallest	Largest
Round		
Oblong		

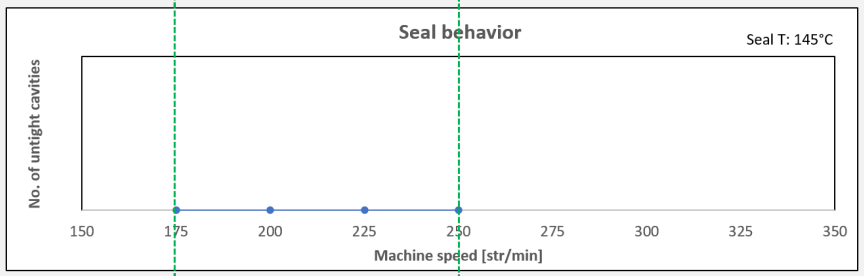
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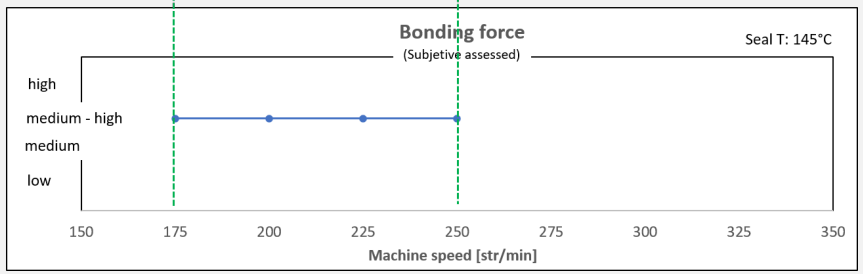
Processing of mono PP blisters[1]
Machine speed; initial status

IMA Giant1 (rotary sealing)



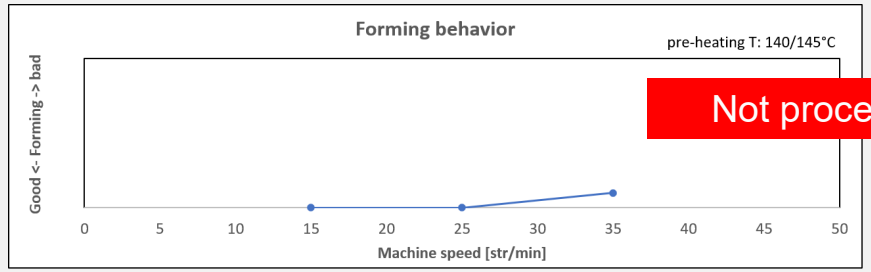
At least up to 10m/min



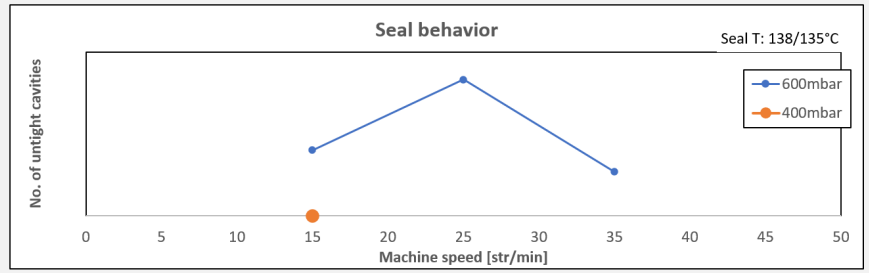


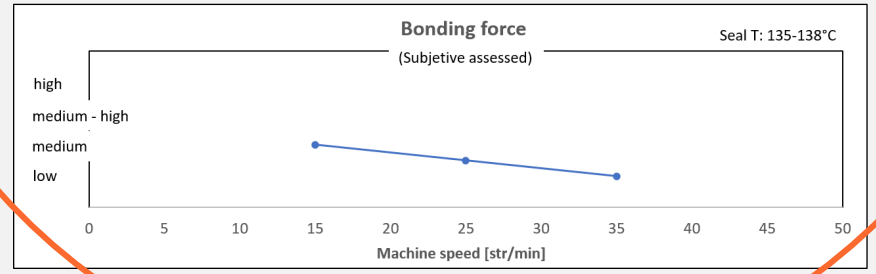
Seal behavior inadequate

Noack N921 (rotary sealing)



Not processible



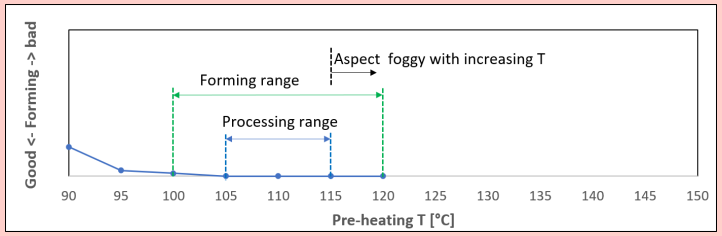
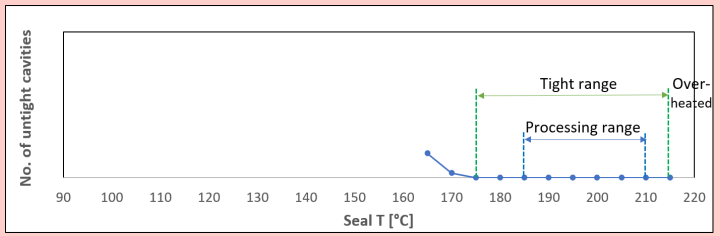
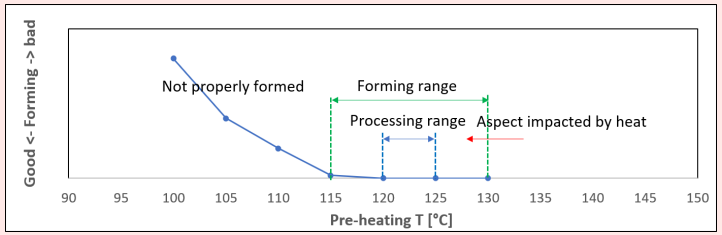
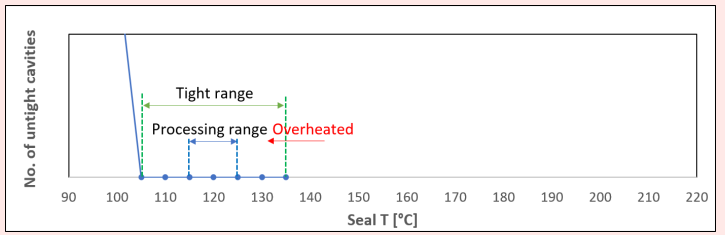
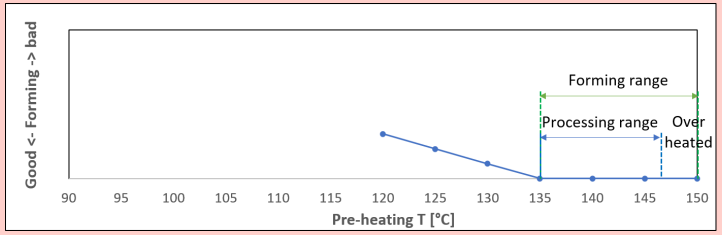
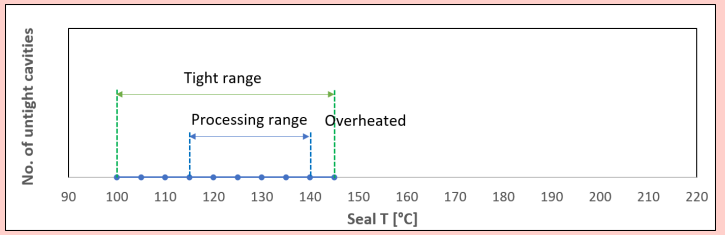


[1] Same old generation PP applied on both machines

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Processing of mono PET, PP & PE blisters[1]
Example: Noack N921, 40 str/min

Status of today

	Forming[2]	Sealing[2]
PET		
PE		
PP		

[1]One example per material type / materials of other suppliers may behave different
[2]Potential processing range defined by Novartis, based on Novartis view

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Mono polymer blisters
Processibility as of today

Highest challenge

Status of materials tested by Novartis

Material	Tooling	Plug assist	Forming T range[5]	Flexo print	DOD print	Seal principle	Registered print	Pre-heating Lid	Sealing T range[5] (tight blisters)
PE	PE (PVC[2])	Recommended[4]	Very tight	Feasible	Not yet tested, but feasible[6] No Corona treatment on blister line required but might be an advantage	Plate	Feasible	None	Very tight and Wide, resp. depending on supplier
						Rotary	Not successfully tested but expected to be feasible	Pre-requisite for processing	Very tight and Wide, resp. depending on supplier
PP/COC/PP	PVC[2]	Recommended at least for larger cavities[4]	Wide	Not tested but feasible[6]	Not tested, but not yet feasible[6]	Plate	Not yet feasible	Today recommended for tested material	Very tight (no pre-heating)
						Rotary	Not yet tested, may be feasible	Pre-requisite for processing	Very tight
PP (new generation)[1]	PP[3]	Proposed[4]	Tight and Partly wide, resp. depending on supplier	Feasible	Feasible no Corona treatment on blister line required	Plate	Not yet feasible	None	Wide
						Rotary	Not tested but feasible[6]	Pre-requisite for processing	Tight and Wide, resp. depending on supplier
PET (scored lid)	PVC[2]	For large cavities potentially	Wide	Not tested but feasible[6]	Not tested, but not yet feasible[6]	Plate	Not yet feasible[6]	None	Wide
PET	PVC[2]	For large cavities potentially	Wide	Not tested but feasible[6]	Not tested, but not yet feasible[6]	Rotary	Not yet feasible[6]	None for medium speed, For high speed likely required	Wide

[1] New developed formulations providing wider forming and seal ranges at lower temperatures vs current PP's
[2] Designed for mono PVC, Duplex, Triplex and Aclar foils; no limitation observed yet, but materials not yet tested on large capacity high speed lines
[3] Considers PP specific shrinkage but for PP also specific surface treatment to avoid that foil sticks on tooling and specific punching behavior
[4] Unheated plugs applied for testing; exception: no plug applied at Sandoz Targu Mures
[5] Effective range depends on machine type applied for processing
[6] Based on supplier information

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From „low hanging fruits“ to complex applications
Mono polymer blister packaging

Machine modifications might be required for commercial supplies

Complexity	Artwork	Material	Sealing principle	Specific info’s
Low	Unprinted	PE, PP, PET	Plate & rotary	Blister in Wallet **or** Printing on demand post blister processing
	Scattered print	PE, PP, PET	Plate & rotary	Variable data embossed **or** included into clichè
	Registered print[1]	PE, PP	Rotary	Variable data embossed **or** DOD printed[2] **or** included into clichè
High		PE	Plate	
Potentially not yet feasible	Registered print	PP	Plate	**Challenge**: PP tends to tear applying the “wedge” for stretching

[1]Online printing proposed / use of pre-printed foil increases the risk at the implementation
[2]Many but not all materials do support DOD printing

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Conclusion

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PVC free sustainable blister materials are processible but require more diligence

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