Release liners

- Liner substrates
- Silicone release coatings
- Coating technology
- Release liner properties

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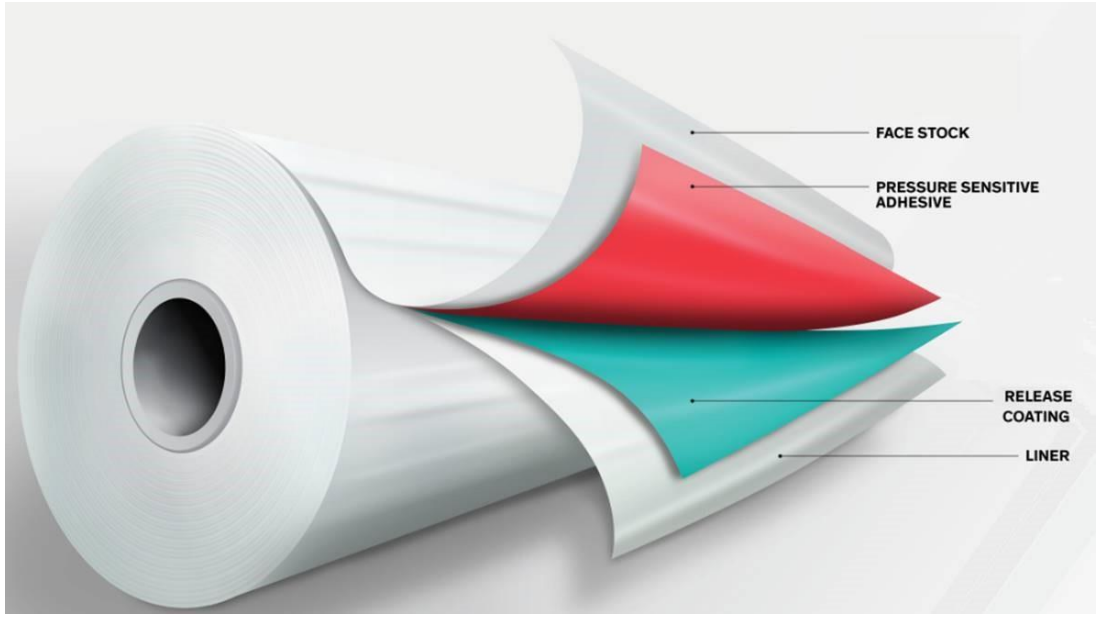
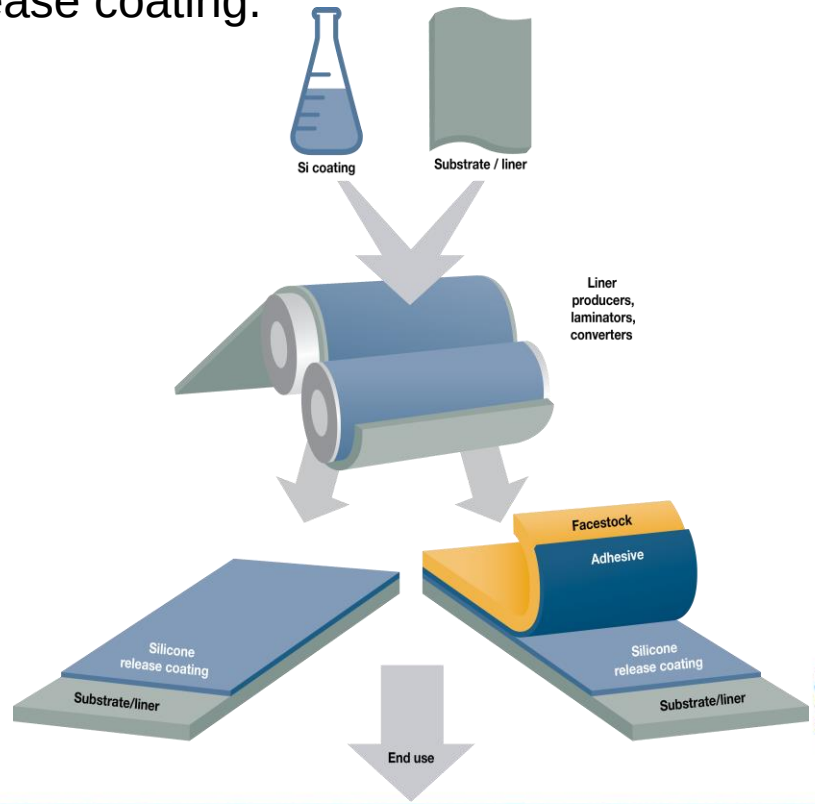
Self adhesive labels – release liner component



- A ‘typical’ self-adhesive label is produced from a ‘laminate’ consisting of a face material against which a PSA layer and a release liner are laminated.
- The release liner consists of a base paper (or film) on which the release coating is applied in liquid form and then crosslinked & dried to leave a silicone elastomer release coating.



The release coating is a very thin layer ~ 1 micron thick (0.001mm). As thin as is possible but still maintaining as complete a covering of the base substrate as possible

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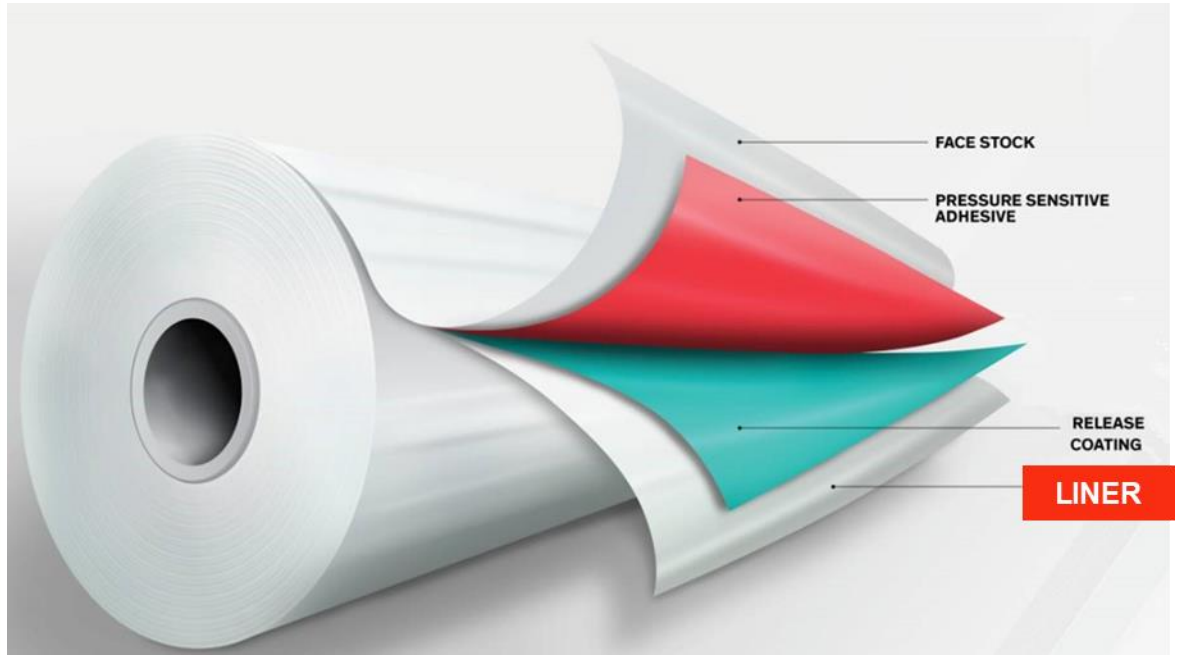
- Silicone release coatings
- Coating technology
- Release liner properties

Release liner - substrate



Two aspects of the release liner substrate are critical for optimum performance;

A. Surface properties;

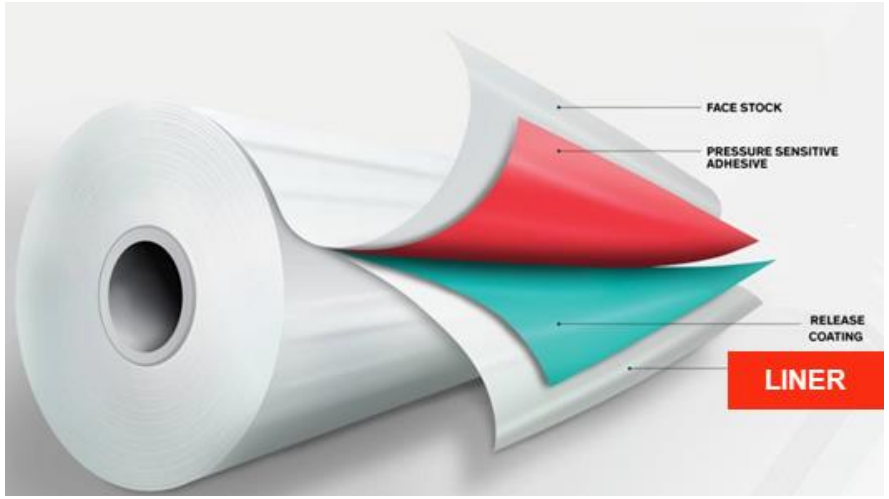
- Closed & smooth surface (to limit penetration of silicone, and need for silicone).
- Minimal impact on silicone cure (poisoning), allows cost advantages
- Encourage robust anchorage (especially at high speed) of silicone to surface, to prevent loss/abrasion of silicone impacting release.

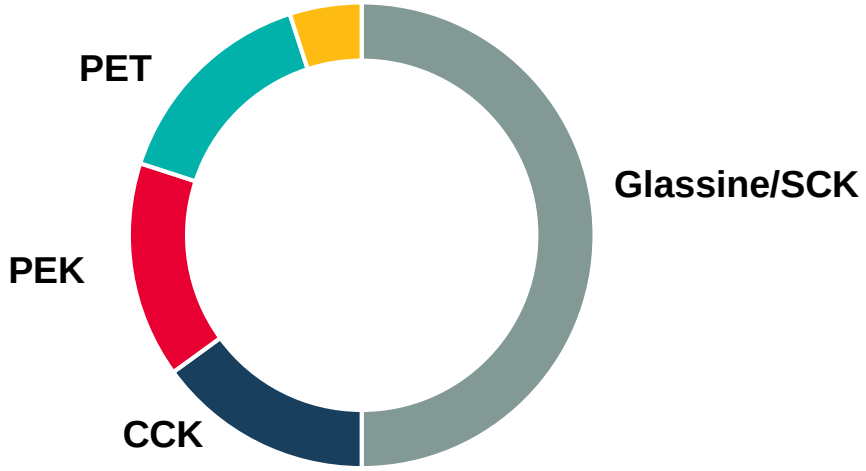
B. Mechanical properties;

- Hard surface (enables better die cutting of labels)
- Reproducible thickness/caliper (allows reliable setting of die cut)
- Tensile strength & tear strength (withstand the stresses applied at high speed).

Both must be balanced vs basic demands on COST.

Release Liner - Substrate





Typical Substrates;

A. Glassine & SCK (Super-Calendared Kraft)
- Very smooth surface, High level of surface refinement (closed)
- Excellent mechanical and chemical properties.

B. CCK (Clay-coated Kraft
- Highly closed surface, Excellent lay-flat properties

C. PEK (Polyethylene coated Kraft)
- Very smooth surface, High level of surface refinement (closed)
- Excellent mechanical properties.

D. PET film
- Very smooth surface (lower silicone consumption), ideal for ‘no-label look’ labels
- Excellent mechanical properties (and transparent)

E. Others
- Some limited use of BOPP substrate.
- HDPE for special applications

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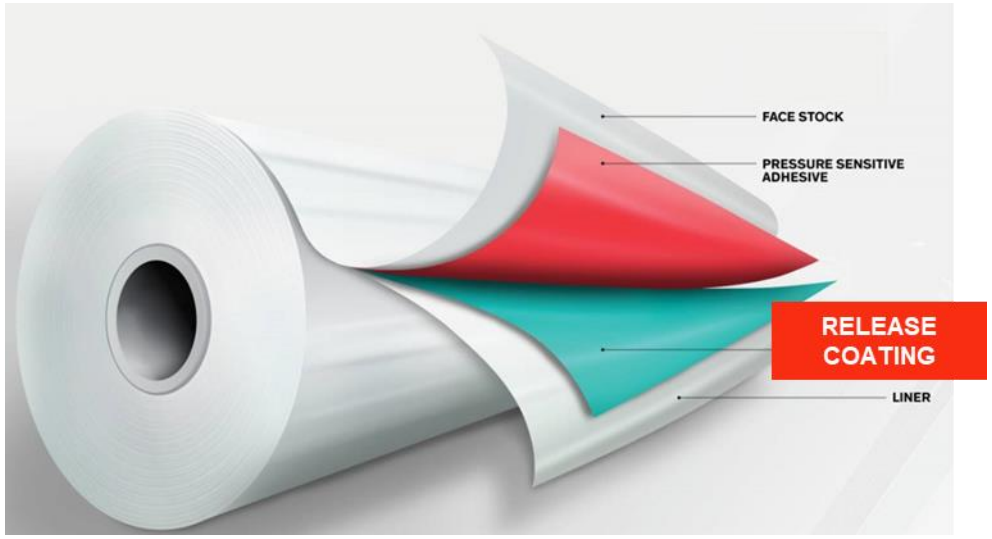
Release coatings - general

“Release coating” definition - A release coating is a specialty chemical that provides anti-adherence properties to:

Protect a pressure sensitive adhesive during manufacture, storage and use

Allow release of sticky materials

For self-adhesive labels, it is release of a PSA which is needed



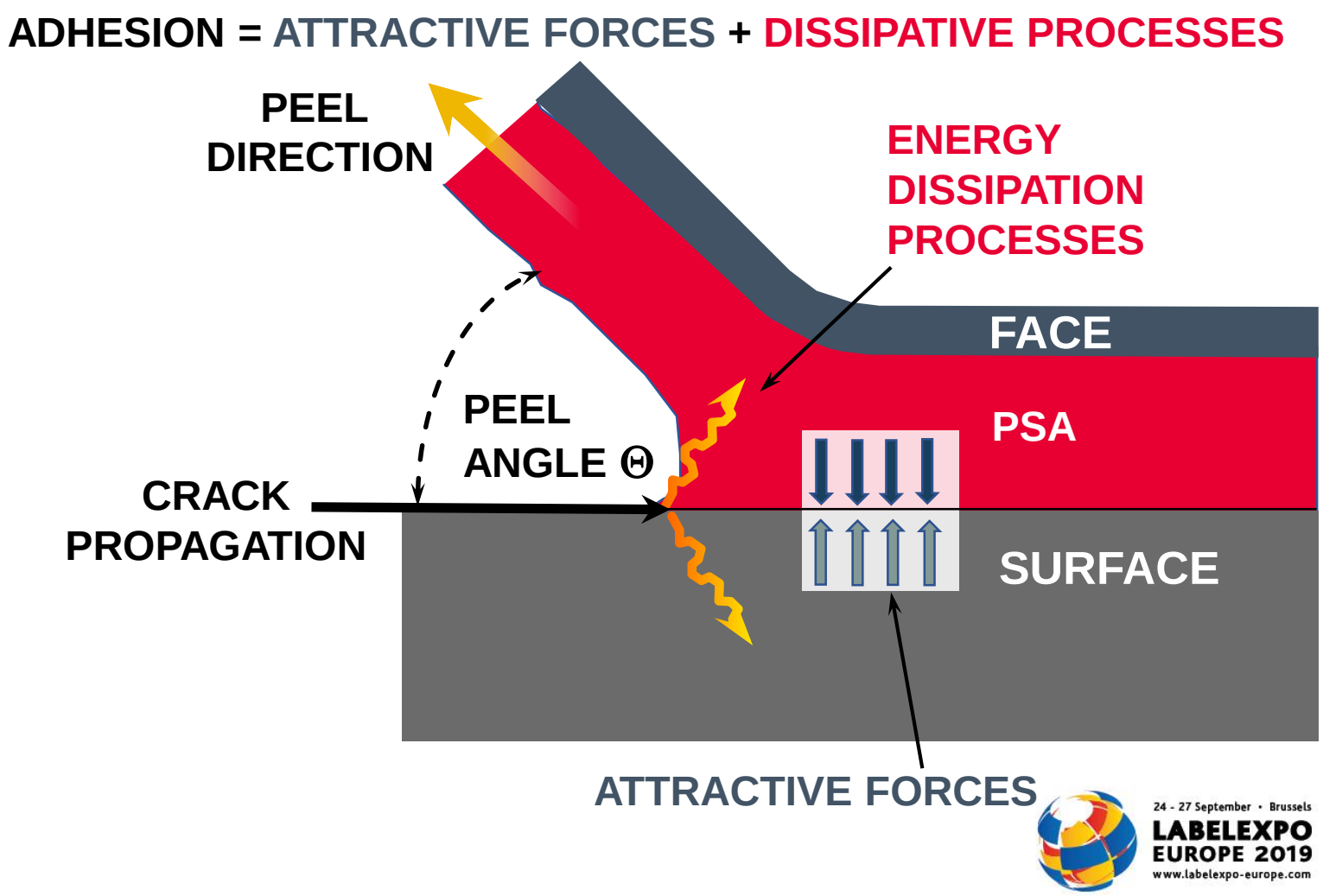
What are Pressure Sensitive Adhesives (how do they work)?

When trying to peel a label away from a surface, we are trying to overcome the ‘adhesion’ of the PSA to the surface.

As with any ‘adhesive’ material, the level of adhesion of a PSA to a given surface is a combination of attractive forces + dissipative processes.

PSA’s generally have a significant component from dissipative processes.

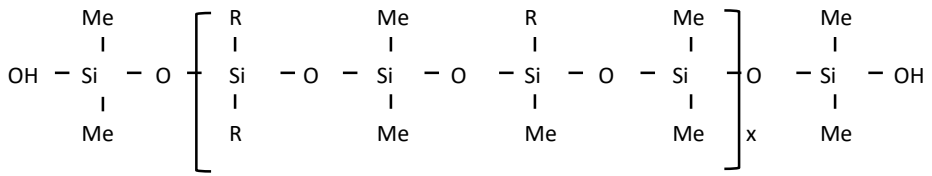
A key reason why PSA’s can ‘stick’ to surfaces that are difficult to chemically bond to (e.g. plastic bottles)



Silicones

Silicones are polymers based on a backbone of Silicon-& Oxygen surrounded by ‘organic’ groups (typically methyl groups; Polydimethylsiloxane – “PDMS”).

Siloxane Polymer



R = (methyl, phenyl, alkyl, OH, vinyl, etc…)

Silicones are typically produced in liquid form, from low viscosity ‘fluids’ up to very high viscosity gels/pastes.

Silicone polymers may be further modified by crosslinking polymer chains to form silicone elastomers (rubber).

Silicone (PDMS) properties

The Most Remarkable Properties of PDMS

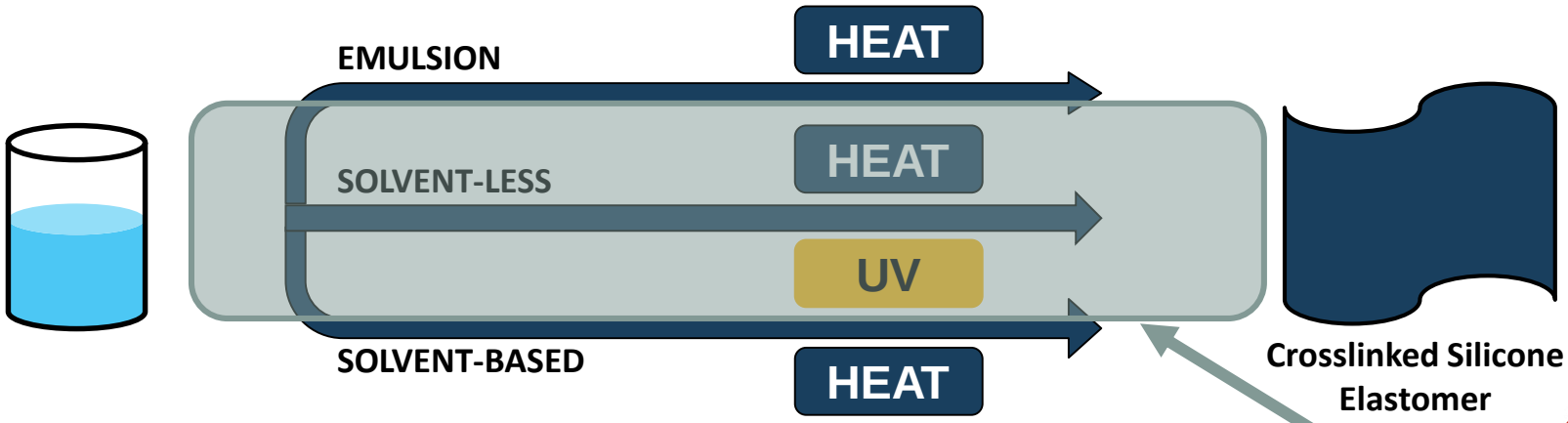
- Low Surface Tension
- Low Variation of Viscosity with Temperature and Pressure

…….are a consequence of

- Low Intermolecular forces
- High Chain Flexibility

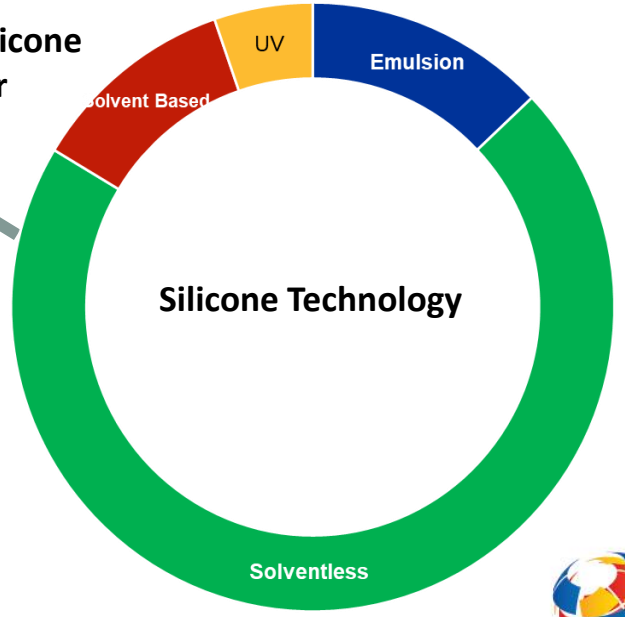
Critical surface tension of wetting (mN/m)	
PE	31
EPR	28
PDMS	23
PTFE	18.5

Silicone release coating technology



Solventless silicone (thermally cured) is used for almost 70% of all silicone release applications.

For label release applications this increases still further such that solventless thermal along with UV are nearly 100%.



FEATURES

- Solvent based, emulsion or solventless. Thermally cured or UV
- Coating ~ 1µm thick of coating
- Coating at up to 1000m/min
- Cure speed of 1.5-3sec or less
- Food contact approved
- Complete surface coverage
- Anchor to the surface
- Remain liquid for min 4hrs

Release liners

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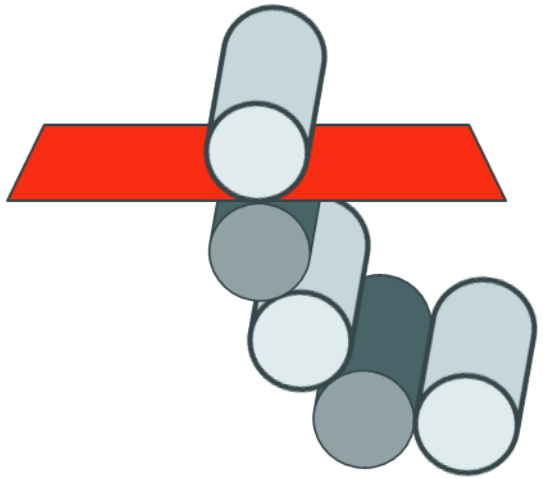
- Silicone release coatings
- **Coating technology**
- Release liner properties

Coating technology

REQUIREMENTS

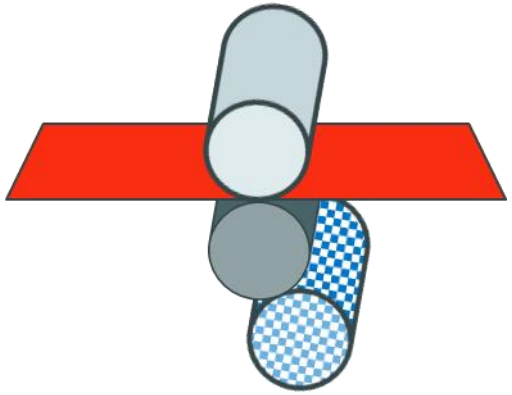
- Coating ~ 1µm thick or LESS
- Speeds up to 1000m/min
- 100% Silicone (Thermal/UV cured)…
- (No dilution of coating)

MULTI-ROLL (5-ROLL/6-ROLL)



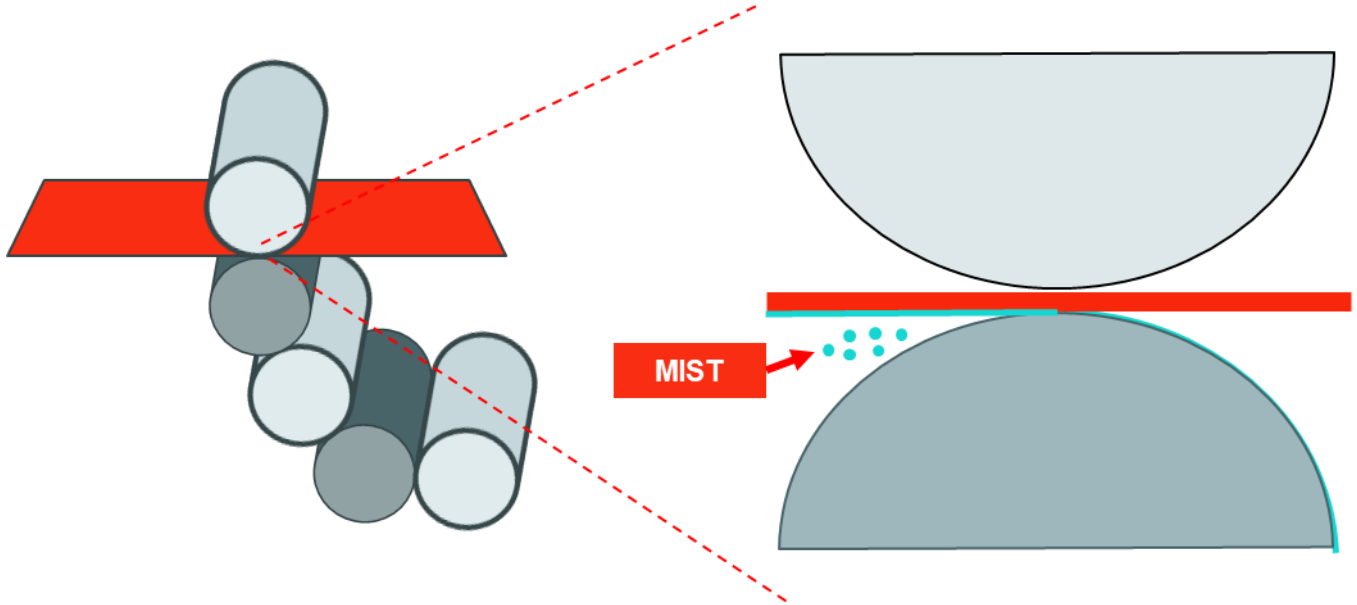
- Offset Gravure limited to ~ 300m/min
- Gravure maintenance important
- Multiroll more expensive
- Sleeve maintenance important
- Roll settings dependent on viscosity
- Multiroll allows easier coat weight control
- Multiroll reduces risk of patterns in coating.
- Multiroll needs cooling for each roll

OFFSET GRAVURE (3-ROLL)



Coating technology - misting

Film splitting as a coating is transferred from one surface to another can generate a coating ‘mist’. Will happen for all coatings at SOME speed (faster the speed, more likely a mist is generated). Mist generation can be significantly reduced (almost eliminated), through use of special ‘additives’ and machine setups.



- Not a major issue at speeds <300m/min
- A significant issue at speeds >800m/min
- Silicone additives can reduce the level of mist generated
- Mechanical modifications possible to limit impact of mist

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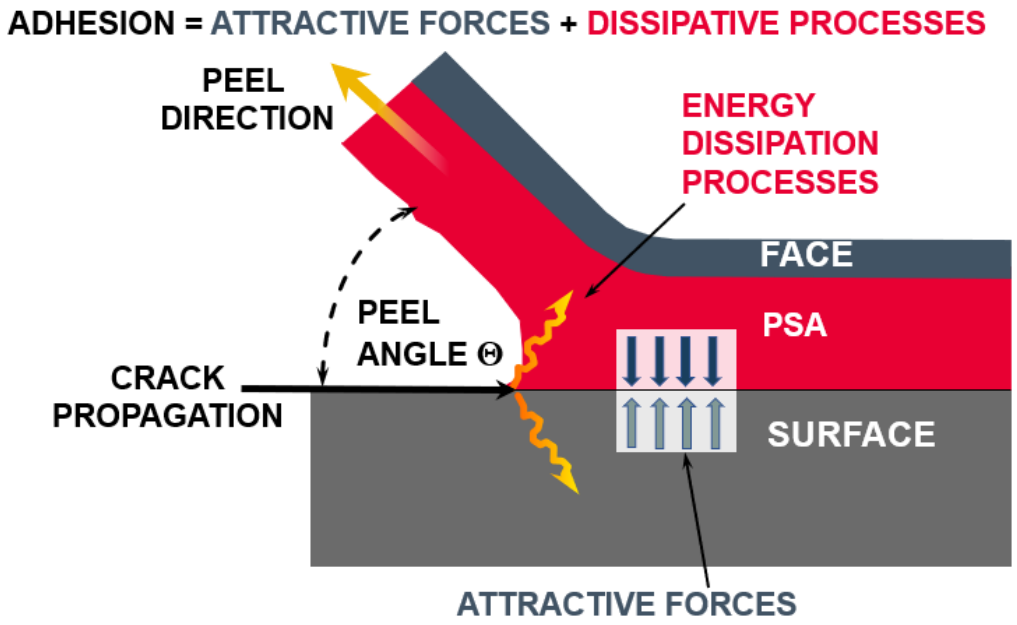
Release liner properties

The key performance criteria of a release liner is the force required to remove the adhesive label from the liner (release force).
Many factors can influence release force;

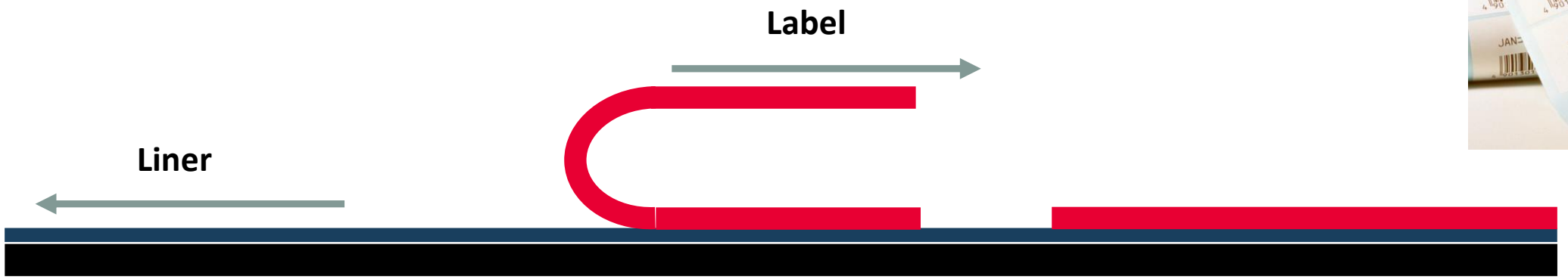
- Quality of silicone coverage on a release liner
- Completeness of silicone cure (crosslinking)
- Silicone release coating formulation
- Adhesive type and thickness
- Thickness & stiffness of facestock and base paper

Liner and laminate producers aim to maintain reproducible and stable performance by controlling all these variables as carefully as possible.



Release liner properties – What is “release force”?

“Release Force” - The peel adhesion force that needs to be applied to remove a self-adhesive label (or matrix in the case of matrix stripping), from the release liner.

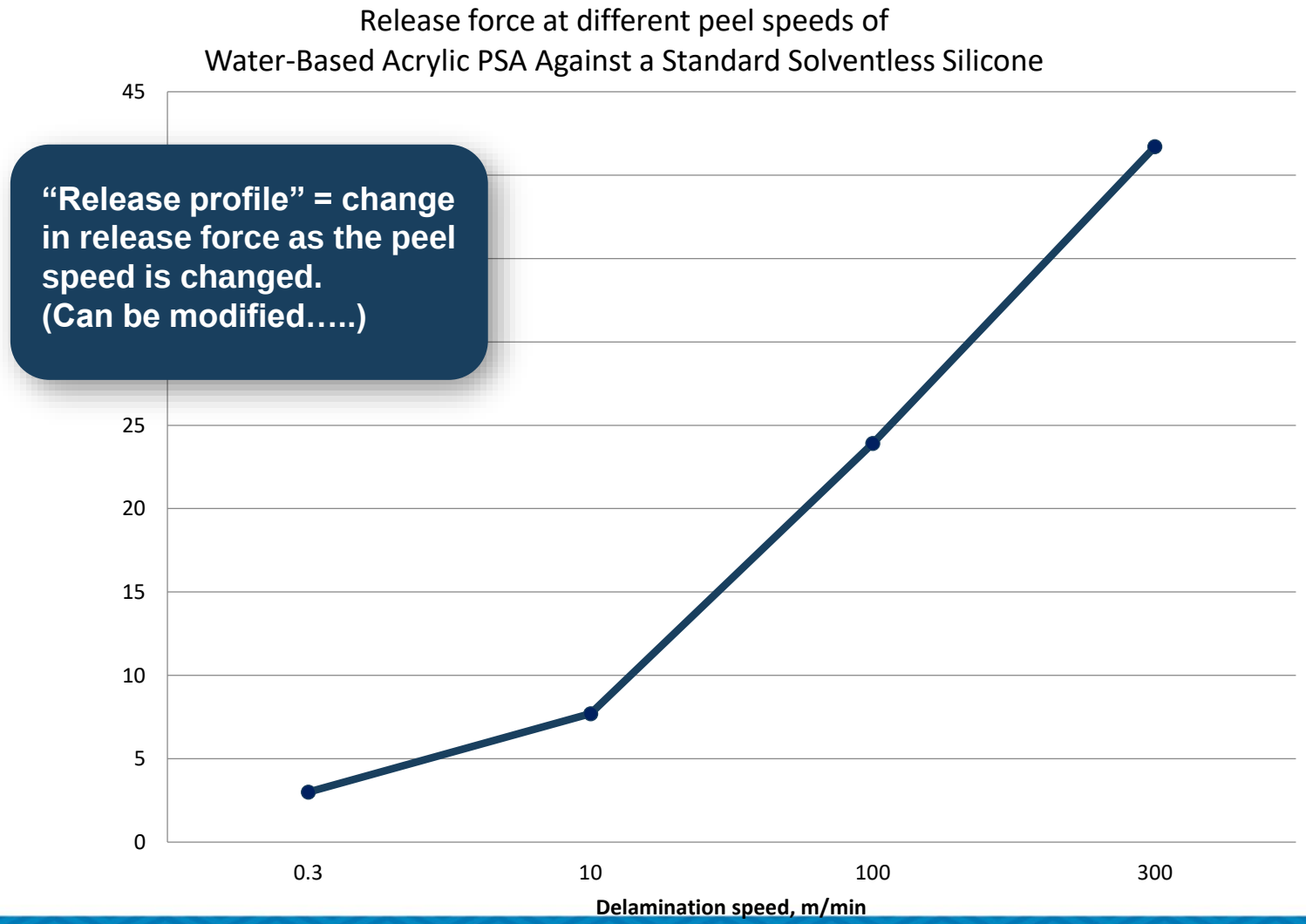


“Release Force” depends on:

- the peel angle (graphic above =180º)
- PSA coat weight
- rigidity of all the materials involved (facestock, PSA and liner)….
- the **SPEED** at which we are peeling the label/matrix away from the liner

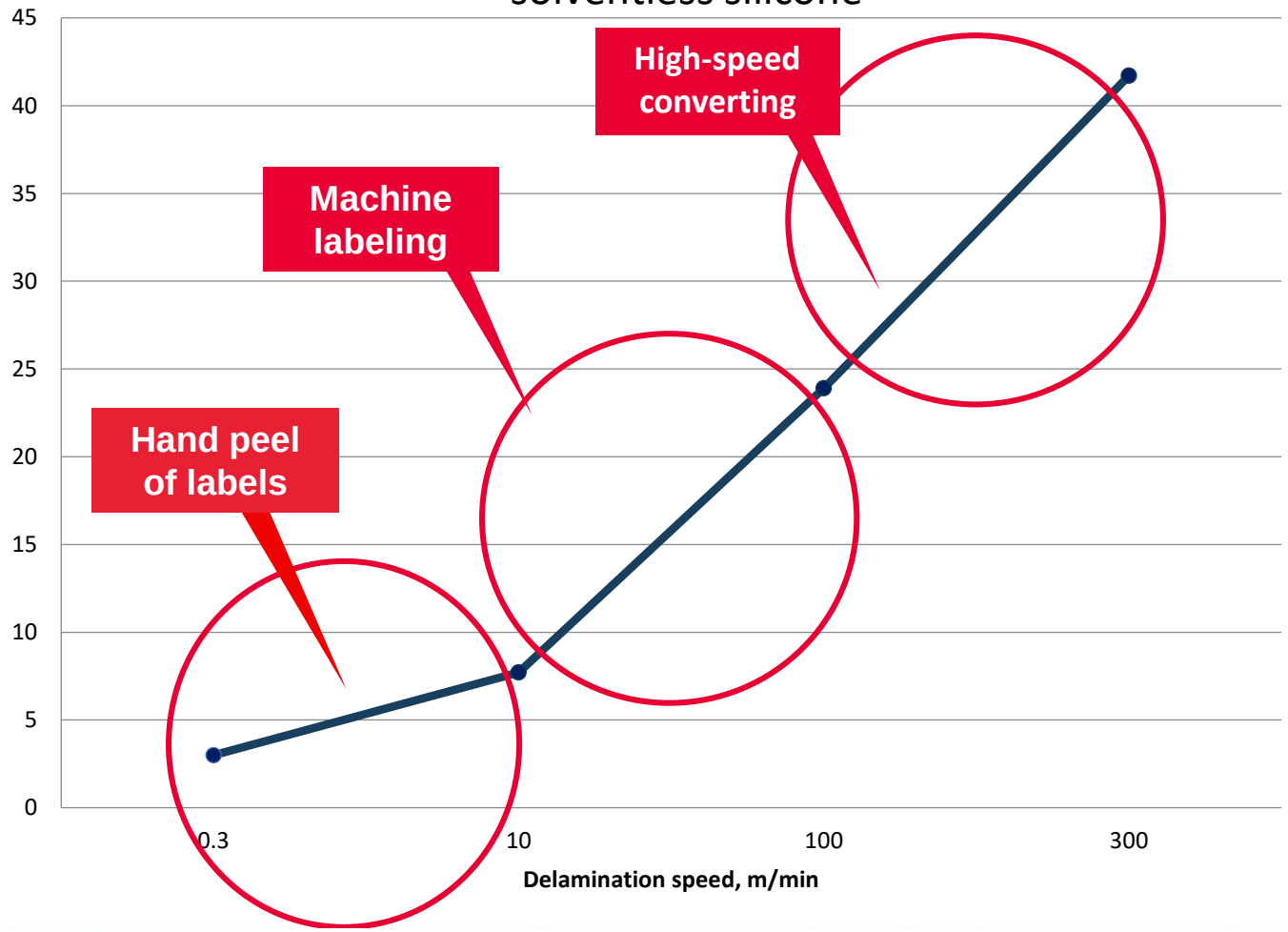
Release liner properties – release profile

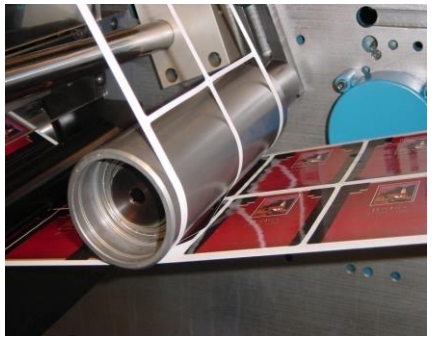
"Release profile" – This is how the release force of a given laminate changes with changes in the peel speed



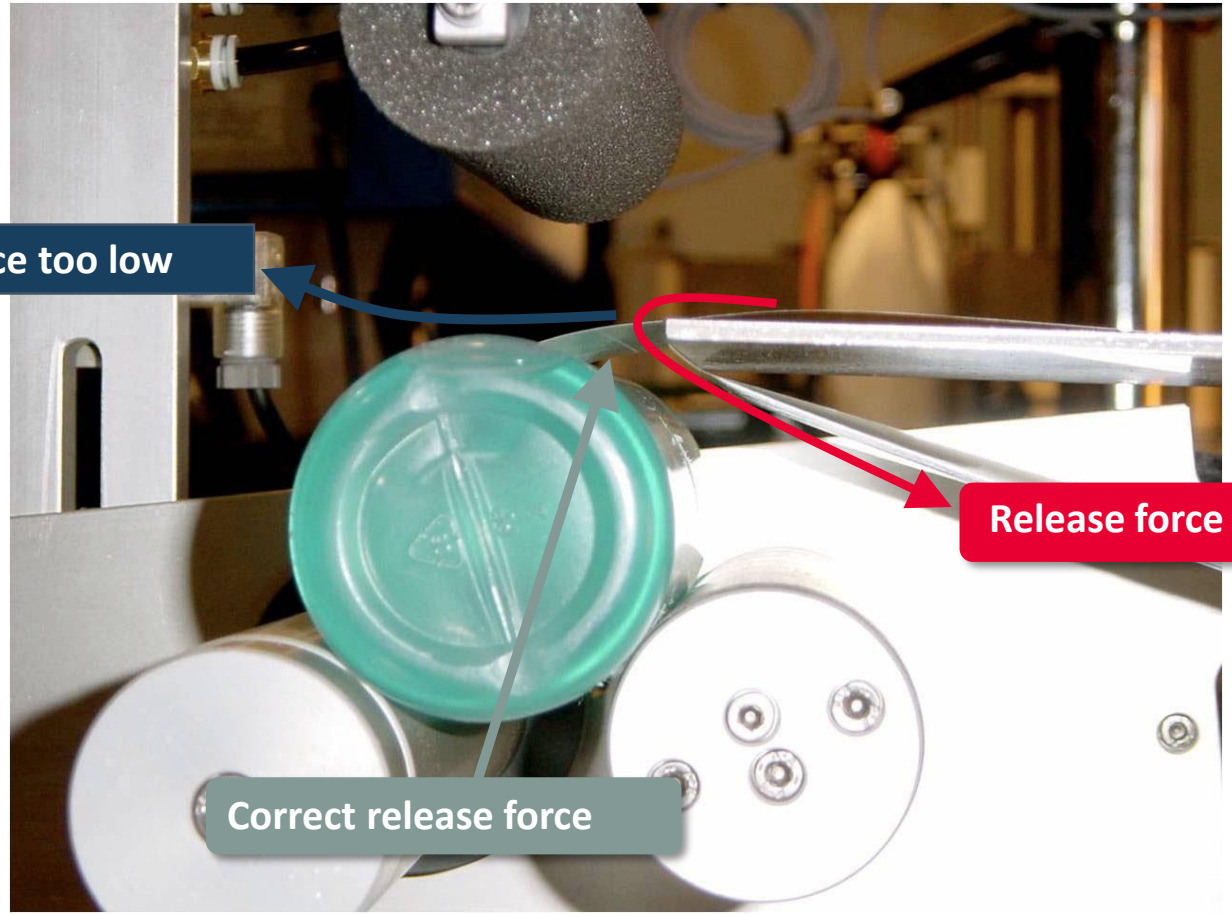
Release liner properties – release profile

Release force at different peel speeds of water-based acrylic PSA against a standard solventless silicone





Release Liner properties – importance of release for labeling



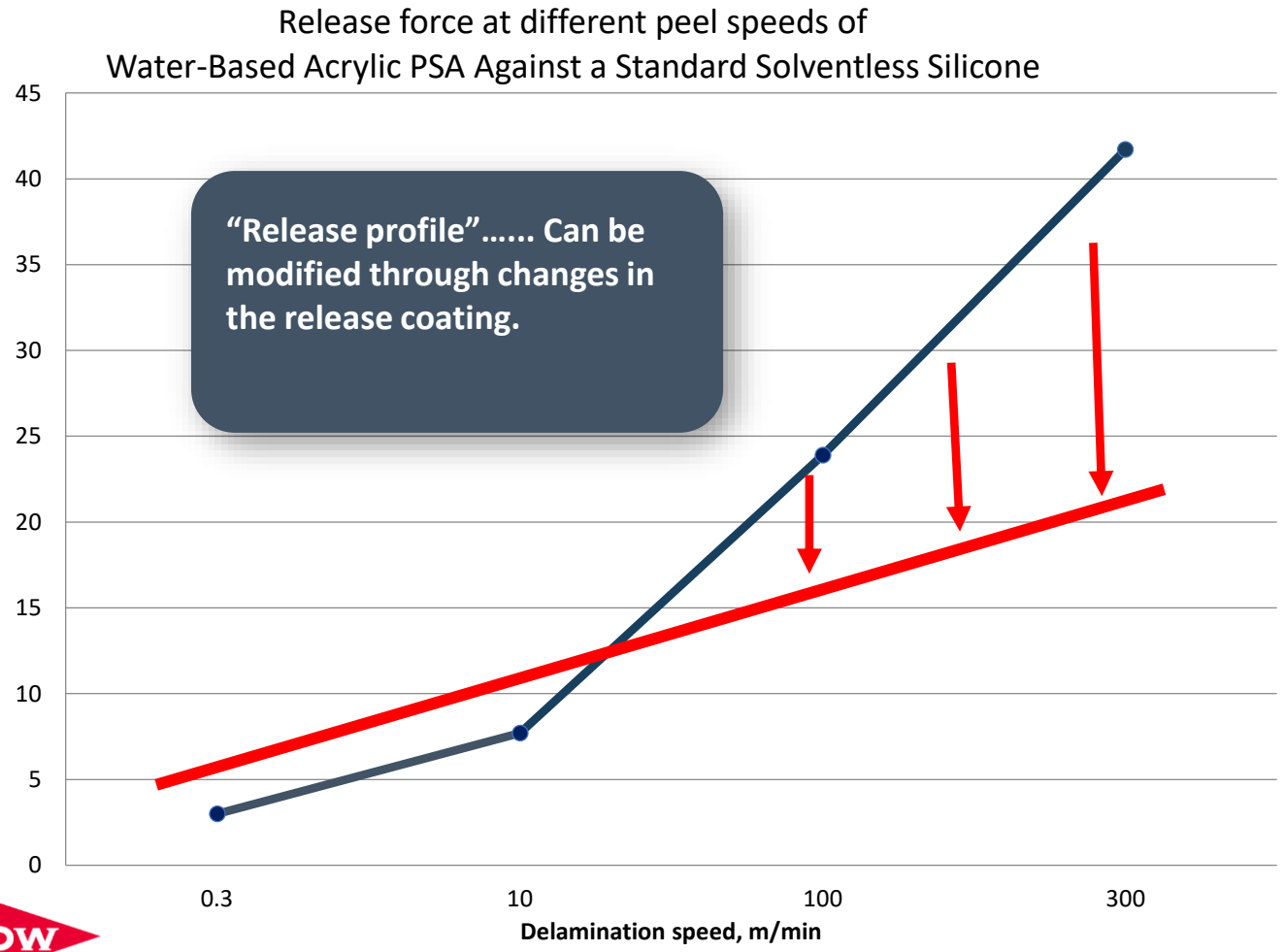
Release force can be critical to performance of labelling at higher speeds.

Release too high - labels not dispensed

Release too low – labels fly off!

Release Liner properties – Flat release

The release profile can be modified to some degree by making changes to the silicone release coating on the release liner. Typically to reduce release force at high peel speed… so-called “flat release”



Lowering release force at high speed can allow higher speed labelling.

Lowering release force at very high speeds can reduce tendency of matrix to break

Release Liner Properties – Silicone coverage

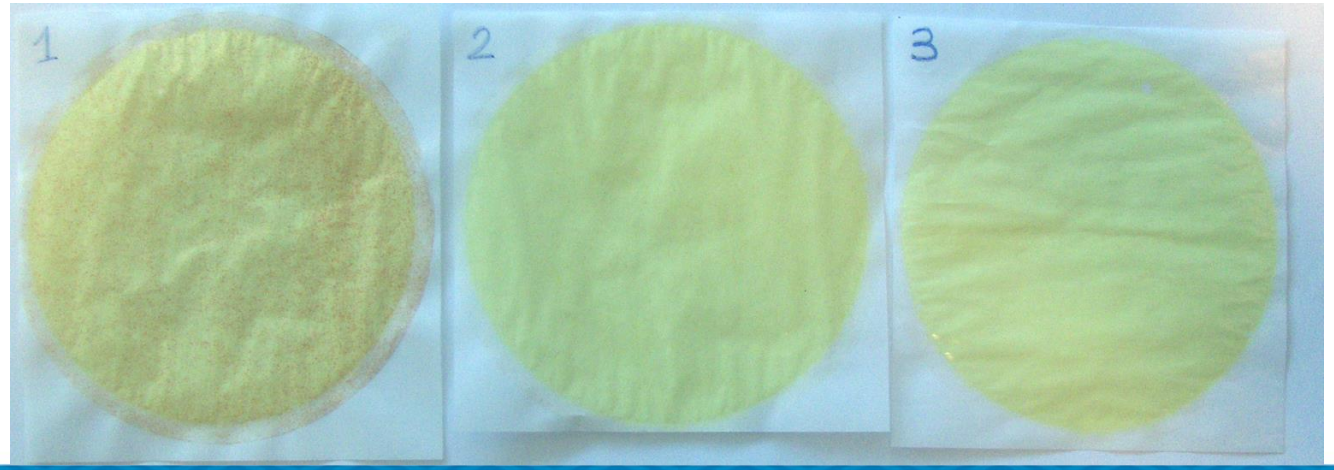
STAIN TESTS

- Apply a coloured stain/dye solution which will colour the substrate but not the silicone.
- Suitable for paper substrates which can be stained.
- Only limited suitability for CCK, not suitable at all for PEK/Filmic release liners.

OPTICAL MEASUREMENTS

- Use of polarized light at a range of frequencies to identify defects in silicone coating, variations in silicone coat weight.
- Suitable for filmic substrates and smoother paper grades.

No silicone = PSA adhesion to the substrate!



Release liner properties – Silicone cure

Silicone cure (how well crosslinked the silicone is), can be measured either directly or indirectly.

INDIRECT (“SAS” measurement)

- Measure Adhesion of PSA to a ‘standard surface’ (steel, glass etc), before and after contact with the silicone release coating. Either with label adhesive or test tapes.
- Measure of the level of silicone migration (contamination) of PSA surface. >85% SAS is good.
- Easy to measure, but is very adhesive specific (i.e. some PSA’s not very sensitive to silicone)

DIRECT (Silicone Extractables)

- Measure % of silicone release coating that can be ‘extracted’ from crosslinked release coating using solvent (MIBK). The higher the extractables level, the worse the cure.
- Need an accurate measurement of silicone coat weight (XRF measurement).
- Measure ‘loss’ of silicone from release liner after extraction with solvent.
  - By XRF (Coat weight measurement before and after Solvent extraction)
  - By Atomic Absorption Spectroscopy (measuring concentration of silicone in solvent).
- Target is Extractables level of <5%.

Thank You

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