



Exploring different Adhesive types

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**LABELEXPO
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Who we are

Henkel at a glance 2018

Around **53,000** employees worldwide

€19.9 bn sales,
2.4% organic
sales growth

€3.5 bn adjusted¹
operating profit (EBIT)

40% of our sales generated
in emerging markets

Around **2,000** social
projects supported

More than **142 years**
of success

¹ Adjusted for one-time charges/gains and restructuring charges.

Who we are

Leading positions in consumer and industrial business

Adhesive Technologies



LOCTITE
TECHNOMELT
TEROSON

Beauty Care



Schwarzkopf **Dial**
syoss

Laundry & Home Care



Persil
Bref



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Objectives of this presentation

What is PSA?

How do self adhesive articles refer to the adhesive?

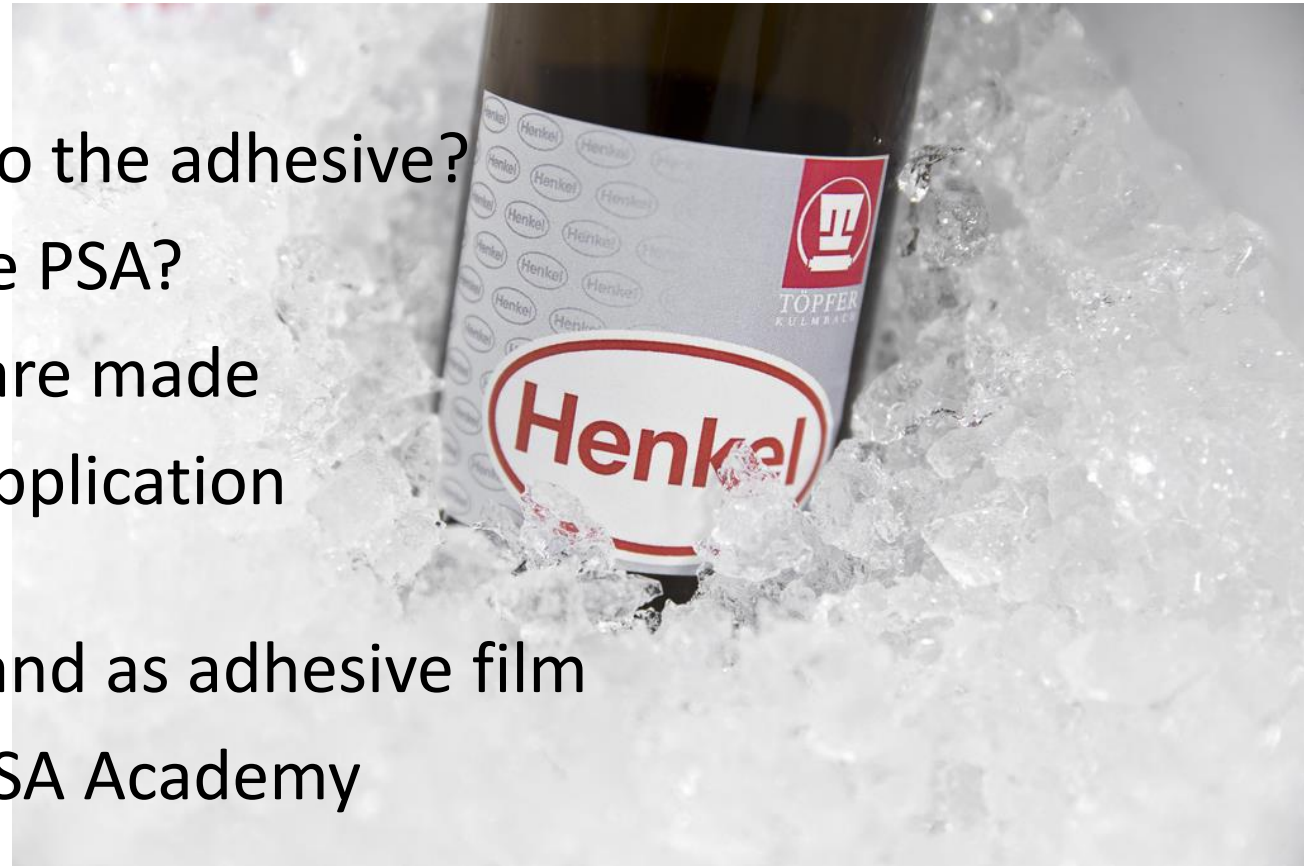
What technologies are used to make PSA?

Brief description of how these PSA are made

Link between PSA technology and application possibilities

Evaluation of PSA, as wet adhesive and as adhesive film

Further education on PSA: Henkel PSA Academy



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Self adhesive laminates



The adhesive is at the core of a self adhesive laminate, requiring compatibility with between various kinds of materials.

Let's focus on the adhesive to understand:

- Do all kinds of adhesives work for this?
- Why does it (not) stick?
- When does it (not) stick?
- How to ensure it will (not) keep sticking?

Nomenclature of adhesives

...universally applicable **permanent** adhesive with excellent adhesion properties on various surfaces. ... very high adhesion on both polar and nonpolar (PE) surfaces. ...suitable for autoclave sterilisation...

extremely high adhesion ... suitable for labelling strongly curved, rough, dusty or oily surfaces ...corresponds to **BS 5609** Section Two (resistance to sea water).

...shows an excellent **removability** on a wide variety of surfaces.

...**semi-permanent** adhesive characteristics. It is repositionable on most surfaces shortly after labelling, but will become permanent

permanent **hot melt adhesive** featuring high initial tack and ultimate adhesion.

glass bottle labeling. Excellent **ice-bucket-resistance** combined with a very high adhesion even at low temperatures

High-performance, permanent **solvent acrylic** adhesive ideal for tight mandrel labeling. Widely used in applications requiring sterilization. Ideal for critical **pharmaceutical** applications

special purpose permanent, acrylic based **UV hotmelt** adhesive

permanent **emulsion acrylic** adhesive with good adhesion to low-energy substrates (e.g. squeezable containers)



What can my adhesive do and what is it?



Adhesion characteristics

High tack

Permanent

Semi permanent

Removable

Repositionable

Reclosable

Technology

Rubber hotmelt

Solvent Acrylic

Emulsion Acrylic

UV acrylic

Silicone



requirements

Low temperature

Ice bucket resistance

Oil and chemical resistance

BS 5609 sea water

Pharmaceutical

Cost (in use)

Food contact

Transparent

Non water whitening

Tamper evident

But what is a pressure sensitive adhesive?

A soft, permanently tacky material that is capable to form an instantaneous bond to almost any surface
(within its application temperature range)

A self adhesive : an adhesive that has an infinite open time

A substance that has both **LIQUID** and **SOLID** characteristics at the same time = visco-elastic

It is a polymer for which we need to understand its flow properties



Technology of pressure sensitive adhesives

Technology	Short description
Solution Acrylic	Loctite Duro-Tak. Liquid polymers diluted and polymerized in solvents
UV Curable Hot Melt	Loctite Duro-Tak UV. Achieve desired performance by curing with UV light. Free radical curing, cationic curing
Emulsion Acrylic	Aquence PS. Liquid polymer emulsions made in water
Rubber Hot Melt	Technomelt PS Physically mixed rubber based solid adhesives, mixed by melting raw materials



Design of PSA polymer



The PSA polymer obtains its properties and limitations from how it is designed and built

- A blend of elastomers, plasticizer, tackifiers and stabilizers can form a rubber hotmelt adhesive. Cohesion of such blend is limited in a temperature range until the adhesive melts.
- An acrylic polymer can be made from its building blocks: monomers and crosslinking agents give permanent, chemical crosslinking.
- Water based polymerization avoids the use of organic solvents and they are built from monomer building blocks.
- UV curable hotmelts combine properties: they are 100% systems but UV curing brings chemical and permanent crosslinking
- Finally, upscaling know-how needs to ensure to bring those properties to tonne scale production

Main characteristics of a PSA

- Tack describes the ability to spontaneously form a bond with another material under light pressure within a short time
- For bonding: the adhesive must be soft enough to follow the shape of the substrate or **fluid** enough to wet out so that the bond can form. The adhesion bond strength develops.
- In a shear test, the **solid-like** behaviour of a PSA gives a cohesive strength that helps to resist deformation caused by a load
- The combination of solid / fluid behavior of a PSA is called visco-elastic behavior.



Comparison of technologies

	Rubber hotmelt	UV acrylics	Solution acrylics	Emulsion acrylics
Performance	Highest adhesion	Balanced adhesion and cohesion	Highest cohesion	Balanced adhesion and cohesion
Ageing, resistance	No UV resistance	Good	Excellent	Limited
Safety	Hot and sticky surfaces	Hot and sticky surfaces, UV radiation	Flammable solvents	Excellent
Storage	Easy	Easy	Flammables!	Frost sensitive
Coating equipment	compact	compact	Large	Large



Quality ensurance of adhesive – **fluid** state

Once manufactured, the (relevant) adhesive polymer properties are checked

Appearance

Solids (non-volatile matter)

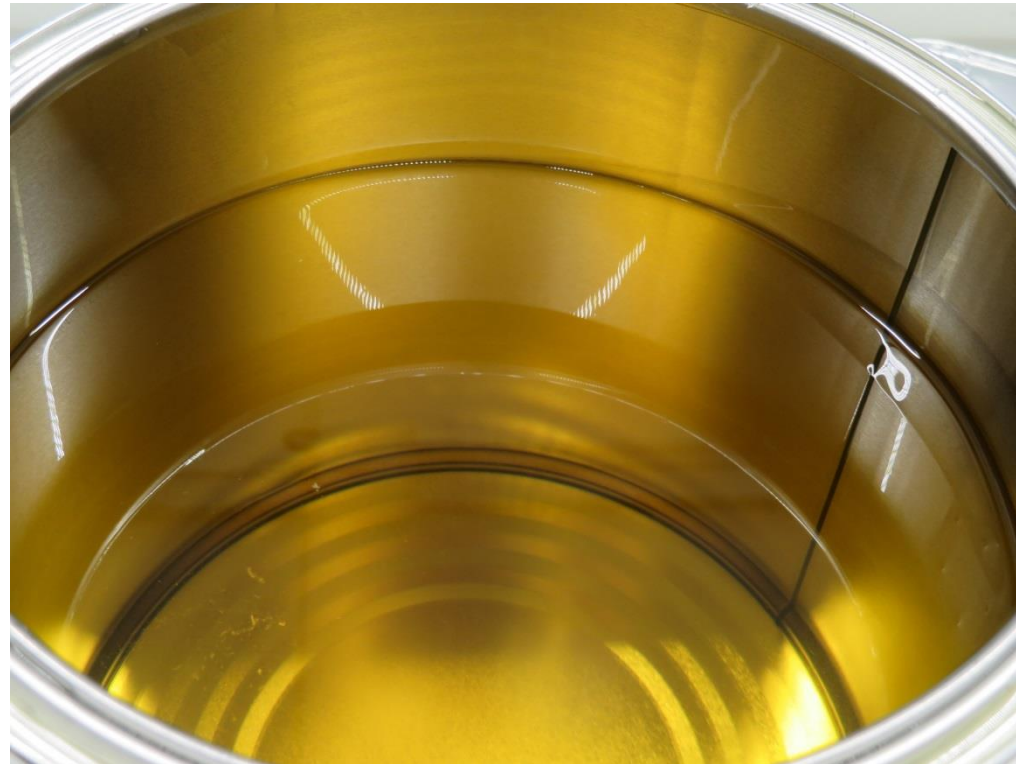
Brookfield viscosity

Relative viscosity

pH

Particle size distribution

...



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From adhesive to adhesive film

How is a self adhesive label made? The fluid adhesive needs to be converted to an adhesive film first.

Depending of the state of the adhesive, different equipment is needed. Each technology of PSA comes with its own challenge.

- Rubber hotmelt : viscosity limits, protection from oxidation,...
- Emulsion acrylic : wet out of the adhesive, foaming,...
- Solvent acrylic : handling flammable solvents, ensure correct curing,...
- UV acrylic : correct usage and maintenance of UV source, ...

Key characteristics of adhesive film

Peel (N/25mm)

This test method describes the adhesion of a PSA on a substrate

Conventional angle is 180° and speed 300mm/min.

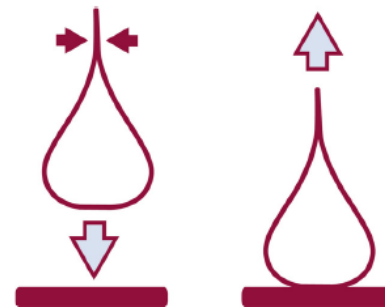
FINAT: FTM1



Tack (N/25mm)

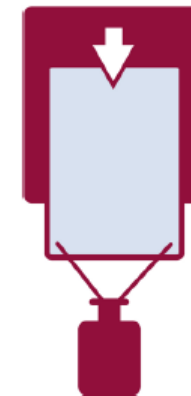
25mm width adhesive strips placed as a loop into the jaws of the tensile tester and lowered onto a clean test plate. Without being pressed, the sample is instantaneously pulled away (300mm/min)

FTM9



Shear (time to failure)

This test methods evaluates the creep resistance of a PSA film under a specific load like 1 kg / 25x25 mm²



Bonded onto steel (or other), evaluation at room temp or other
FTM8

Adhesive failure

Testing for adhesion and cohesion also gives information on **how** the debonding process went.

- Adhesive failure

- Cohesive failure

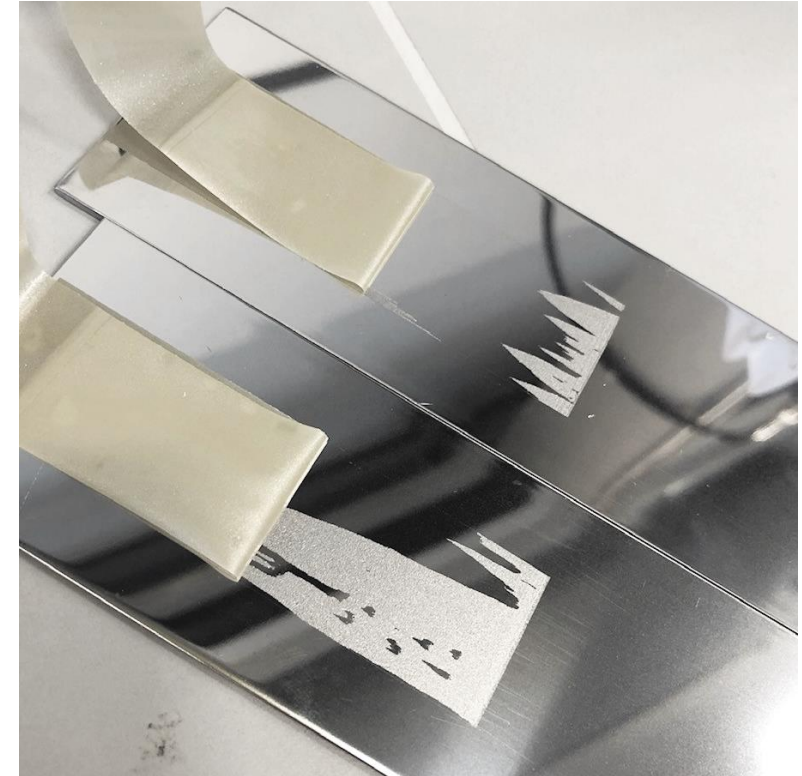
- Transfer of adhesive

- Mixed mode failure

- Panel staining

- Material change (color, break)

This is part of your troubleshooting!



(Some) label specific test methods

Adhesive ageing test	Example: 96 h at 175°C
Migration and penetration	Laminate will be tested in time steps at 75°C for finally 48h. Check loss of whiteness.
UV ageing	UV-light treatment directly on adhesive surface. Evaluation of change in color, tack.
Material interaction	Individual, impact of interaction between adhesive and substrates under defined conditions
Mandrel performance	Applying labels on round bottles with different diameters and check for flagging
Label wash off behaviour	Specific methods for one way vs returnable bottles and depends on materials



Henkel PSA Academy

Henkel offers a **Certified** Training Course for the handling and application of Pressure Sensitive Adhesives. The "Henkel PSA Academy" was developed in close cooperation with the Chamber of Commerce and Industry (CCI) which assures you a high quality standard of the training and gives you the opportunity to become a CCI-certified "Technical Specialist in HM Pressure Sensitive Adhesives for Labels, Tapes and Special Applications (CCI)".

Henkel
PSA ACADEMY

Learn more about our
PSA Academy

IN COOPERATION WITH
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Summary

- At the core of Self adhesive label materials, there is the adhesive
- We looked at various names, descriptions used for these adhesives
- We have explained what a PSA is...and why such polymers show this PSA behavior
- We went into detail on the different kinds of PSA polymer(s) (blends)
- Next, PSA need to be converted into an adhesive film before using
- ... and coating technique depends on the PSA technology
- Then the adhesive film can become part of the label
- ... and many methods exist to check key properties, like peel, tack, shear
- ... and many label specific test criteria

For more learning, check Henkel's www.pressure-sensitive-solutions.com/



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