

The ink, the glue will not stick!

Wetting describes the behaviour of a liquid ink and the liquid glue on a solid surface.

Adhesion means the force, which must be applied, to remove a solid ink or glue from the substrate.



no wetting

wetting

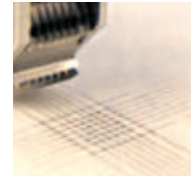
The wettability of a substrate must be sufficiently high to obtain a brilliant, sharp print; i.e., an optimum of wettability enables the possibility to distinguish „6“ and „8“. Also the kinetics of the application of the ink during the printing process are influenced. Good wetting is necessary for a good adhesion, but not sufficient, i.e. other parameters play an important role besides wetting for the adhesion process.

In contrast to adhesion, wetting is easily accessible to experiments and can be determined before printing and gluing. In principle, adhesion can be determined only after printing and gluing, since it is a property of the combined system.

Methods of adhesion measurement

Carved screen test

The layer must be carved crosswise. The fraction of delaminated area is a measure of the adhesion.



Bending test

The coated substrate must be bended over a conical bolt. The radius at which delamination occurs is a measure of the adhesion.



Direct measurement

A tape, which was tightly pressed with a roller onto the substrate, must be pulled off perpendicularly using a 100 g-spring scale.

We recommend our corona- and AP-Plasma-Systems to improve the adhesion on your substrates.

Theory of wetting

Young's equation

The angle Θ , which forms the surface of a liquid in the contact point with the substrate, describes „wetting“ in a quantitative way.



The angle Θ is determined only by the surface energies of the liquid σ_l and the substrate σ_s . YOUNG's equation holds:

$$\cos\Theta = (\sigma_s - \sigma_{sl}) / \sigma_l = \sigma_c / \sigma_l$$

σ_{sl} is the contribution of the contact area, which cannot be measured directly. *Critical surface energies* σ_c measured with *test inks* can be found in tables for many materials.

Rule of thumb for printing and gluing:

$$\sigma_s > \sigma_c$$

Surface energies consist of a polar and a non-polar (disperse) part. While wetting depends only on σ_c and σ_l , adhesion depends additionally on the polar fraction of the surface energy of the liquid and the substrate. I.e. it cannot be concluded equivocally from a measurement of σ_s of a substrate with test inks on the adhesion of an ink or glue on this substrate.

Theory of adhesion

The main mechanism of adhesion

1. Clean surface

Adherent layers separate inks or glue and substrate: e.g. oil on metals, gliss agents on plastic films and deforming agents on moulded plastic parts.

2. Mechanical anchoring

The filling up of cavities in the surface of the substrate with inks or glues anchors the layer with the substrate.

3. Chemical bonding

between the molecules of substrate and ink or glue anchors at atomic level.

4. Good wettability

enlarges the contact area and prevents micro-pores, which act as a predetermined breaking point.

5. Gain of energy

The gain of energy, which appears by the formation of the contact area, is equivalent to the physical work, which must be applied at the separation.

The contribution of the single mechanism to the adhesion of a layer cannot be recognized in practice. While mechanism 3 can be influenced by the choice of the ink or glue, a pre-treatment with electric discharges always increases all other influenced mechanisms.

What to do?

1. Select an ink resp. glue, which fits chemically to your substrate.
2. Determine the surface energy of your substrate.
3. Use a pre-treatment of your substrate.

A pre-treatment with electrical discharges increases the adherence on your substrates.

The perfect surface

- is clean,
- exhibits high wettability and
- fits chemically to the ink or glue.

„WETTING IS NOT IDENTICAL WITH ADHESION“

- Send us samples of your substrates!
- We examine the possibilities of a treatment.
- We return the samples or send you a demonstration unit for your adhesion tests.