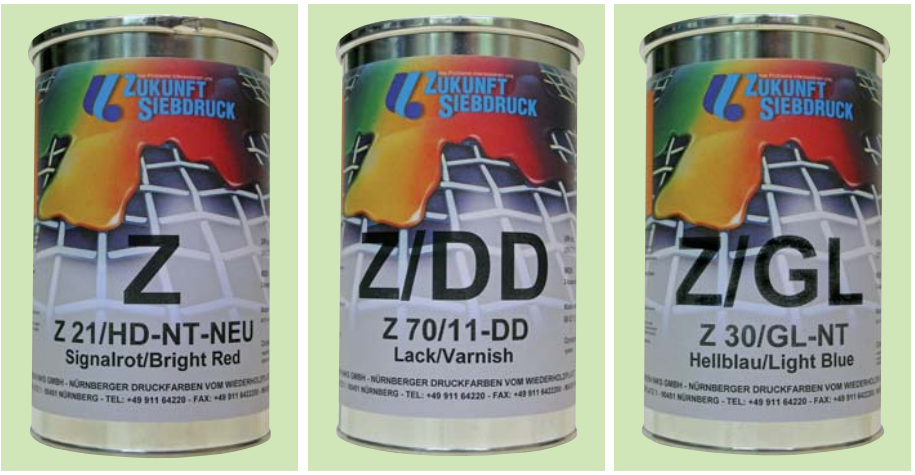
PROCESSING OF 2-COMPONENT INKS

Johann Bauer
Applications
Department

Generally 2-component inks (2-c) are used for long-lasting screen and pad prints on substrates such as glass, metals, duroplastics, polyolefins and similar materials. 2-c inks are also essential if you want to achieve exceptionally high physical resistances (light fastness, weather resistance, abrasion resistance etc.) and/or high chemical resistances. Compared to 1-component inks (1-c) working with 2-c inks is much more demanding. Errors or carelessness during processing may result in significant quality problems. In the following article we want to outline important issues of processing 2-component inks, describe the problems causing reduction in quality of prints and inform about the essential properties and various versions of 2-component inks.



THE DIFFERENCE OF 2-C INKS

The main difference in processing 1-component and 2-component inks is that 1-c screen and pad inks of solvent based ink systems are adjusted for printing with thinners/retarders prior to printing. They dry by evaporation of solvents. Then the ink layer is technically "finished". However, due to their formulations 1-c inks show none or only limited resistances against aggressive chemicals (solvents, acids etc.). The advantage in processing 1-c inks is easy cleaning of any ink dried into stencils and tools with solvents or cleaning agents.

2-component inks are a different story. A pre-determined amount of the second component, the hardener is added prior to the addition of thinners/retarders. Then after printing, such inks initially also dry by evaporation of solvents before the full chemical reaction between hardener and binder begins. A print carried out with 2-c inks is not "ready" before cross-linkage reaction between hardener and binder is completed. Only then the print shows the specific high resistance properties.

PREPARATION FOR PRINTING

Principally all processing steps need to be carried out carefully. If a 2-c ink does not achieve its full specific quality features, this is often due to incorrect preparation.

SELECTION CRITERIA

- 2-component system suitable for the requirement (see ink charts of Coates Screen Inks GmbH).

- Hardener must be suitable for ink system and requirement profile, e.g.
  - Hardener ZH only for prints used indoors as this hardener tends to yellow under the influence of UV-light.
  - Hardener ZH/N also for outdoor use, non-yellowing. Mainly for prints onto soft or flexible substrates such as TPU/TPE, synthetic materials.
  - Hardener range ZH/GL only for screen printing inks Z/GL.
- Shelf life: hardeners have a much shorter shelf life than printing inks. Minimum storage time is between 6 months and 1 year. Please refer to the best before date printed on the labels.

  If not stored properly (insufficiently closed cans) the hardener may even become unusable before that date. Spoiled hardeners show signs of crystallization, increase of viscosity etc.
- Use only hardeners and thinners recommended for 2-c inks (please refer to product data sheets of the relevant ink types) as some solvents react with hardeners.

ADJUSTMENT OF 2-COMPONENT INKS FOR PRINTING

- Stir ink well in its original container to ensure an even distribution of all ingredients.
- Carefully weigh correct amount of ink needed for printing. Use only the amount of ink which can be processed within the pot life (time period ink can be used after mixing with hardener) for long-term printing jobs.
- Calculate amount of hardener required for that amount of ink.
- Mixing ratio ink : hardener significantly varies from ink range to ink range, ranging from 20 :1 (e.g. Z/GL) to 2 :1 (e.g. TP 260).
- Carefully weigh correct hardener, add to ink and stir in well. Insufficient hardener distribution in the ink will cause quality problems.
- Always tightly re-seal opened hardener cans, as hardeners will react with humidity.
- Ink is only thinned and/or retarded AFTER hardener addition.
- After mixing we recommend to allow inks to pre-react (degassing) for about 10 minutes before printing.
- Ink is now ready to print.

PRINTING

Printing process is technically the same as that of 1-component inks, however, there are some special issues you have to consider during printing.

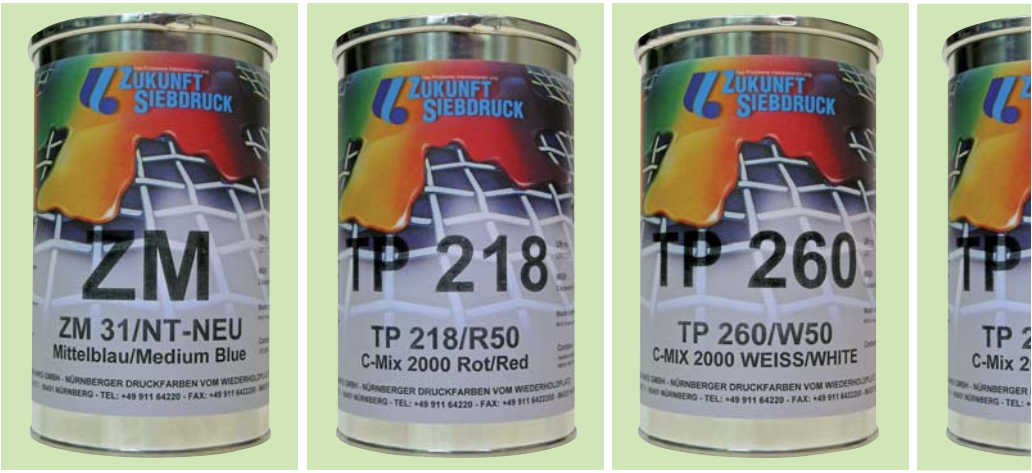
POT LIFE

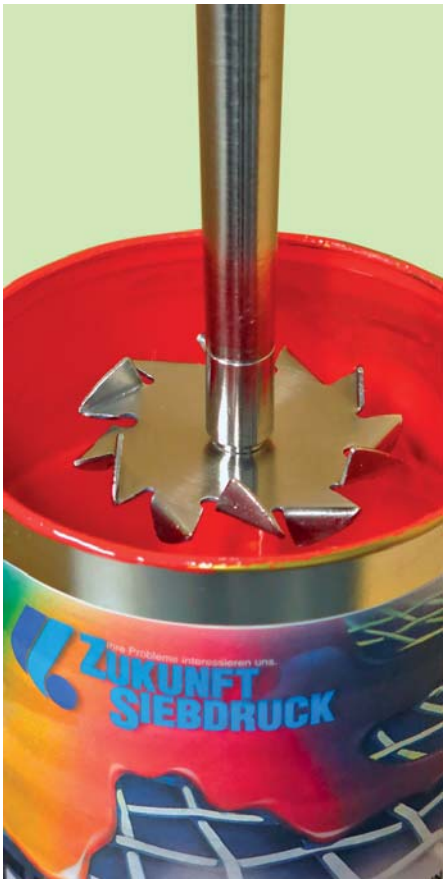
Cross linkage reaction between binder and hardener starts at the time hardener is added to the ink. When a certain degree of cross linkage is reached ink can no longer be used. That's why technical data sheets supplied by ink manufactures contain information regarding the pot life of readily mixed 2-component inks. Depending on ink type this is usually a period of time ranging from 2 - 12 hours. On account of various factors influencing this pot life such as pigment type, pigment content, temperature of ink, degree of thinning and printing conditions the pot life of an ink range can never be exactly determined for all colour shades of a complete ink range.

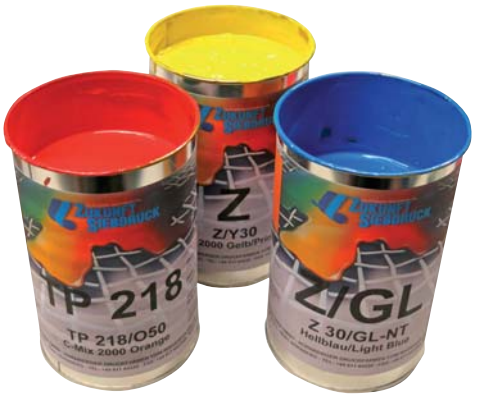
- The indicated pot life always refers to processing temperatures of 20 °C. The higher the temperatures the shorter the pot life. Here you can apply the rule of thumb: 10 °C temperature increase will reduce pot life by half (possibly even a much shorter pot life).
- If an ink becomes or remains too thick even after re-thinning, pot life has been exceeded.
- It is not recommended to store mixed inks in a refrigerator to "extend pot life". This may cause an irreversible stop of the cross linkage reaction. Such assumed cost savings may turn out to be very expensive.

TIME FRAME FOR OVERPRINTABILITY

Printing of multiple layers should be completed within 12 hours. If time periods range from 12-24 hours pre-tests should be carried out to check for intermediate ink adhesion.







CLEANING

Stencils and tools should be cleaned as quickly as possible. If 2-component inks remain on stencils and tools for longer periods, cross linkage reaction will proceed and cleaning will become difficult.

DRYING, CURING (CROSS LINKAGE)

There is a difference between ink drying and the following curing (cross linkage) of the ink. Please note that effective cross linkage is only possible after the printed ink layer has dried completely. Essential factors like temperature and humidity also have to be considered.

MINIMUM REACTION TEMPERATURE

Every hardener requires a certain minimum temperature for cross linkage with the (printed) ink. There will be no reaction below this temperature. If temperatures fall below the minimum requirement for longer periods during the curing process, cross linkage will stop irreversibly. As hardeners also react with water high humidity should be avoided as well.

Examples for minimum temperatures of hardeners:

- Hardener ZH, TP 219: ≥ 15 °C
- Hardener ZH/N, TP 219/N: ≥ 20 °C
- Hardener TP 219/L: ≥ 140 °C

REACTION TIME

The reaction time is defined as the period of time after printing and drying until the maximum possible curing/ cross linkage of ink and hardener is completed; a combination of time and temperature of prints (also in storage).

Drying/curing takes place at room temperature (20 °C).
Basically curing times are as follows:

- Minimum 72h at ≥ 20 °C
- Optimum 120h at ≥ 20 °C

DRYING/CURING AT HIGH TEMPERATURES, OVEN CURING

Drying time can be reduced if higher temperatures are applied. A temperature increase of 10 °C will double the speed of reaction, thus you will only need half the time for the reaction. Curing of many 2-component inks oven-dried at a temperature of 140 °C will be completed after 20-30 minutes. These values may be different with some ink types.

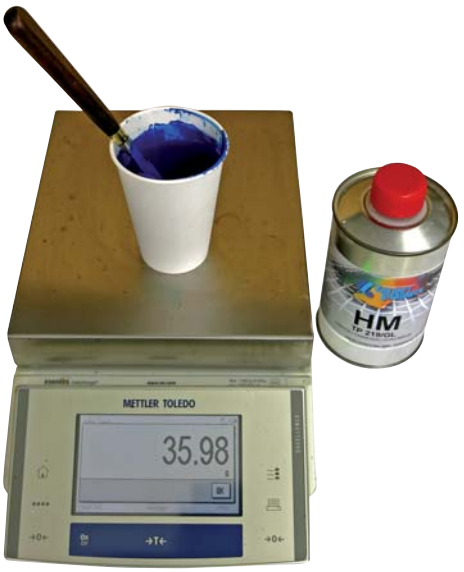
DRYING / CURING ERRORS

- No temperature control of substrate. The surface of substrates stored at cold temperatures will become humid when brought into warm rooms. Hardener will react with that humidity. Hardener reaction may be stopped because of the slow warming up process, especially on solid materials, such as thick glass sheets, metal or plastic boards.
- Prints are moved to cold store rooms too early (=before reaction is completed): "time is money!" - if prints are moved to cold rooms too early or transported on trucks during extremely cold winter nights before reaction has finished you may suffer a significant financial loss.

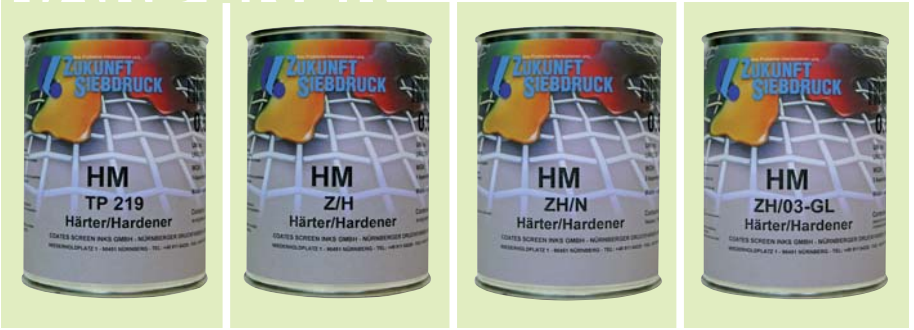
QUALITY TESTS

Reliable resistance tests of 2-c inks can only be carried out after correct and complete reaction of the printed ink layer(s). Often these tests are performed much too early - during the reaction time. Thus tests will show insufficient results.

Basically reaction time may be reduced by oven curing (see above). Then quality tests can be carried out after 3-4 hours (drying/oven/cooling) instead of the 72 or 120 hour period required when air drying. However please note that depending on ink type, hardener, substrate there may be significant differences between values of oven and air dried prints. Often oven cured prints show better values.



HARDENER



Johann Bauer
Applications Department
+49 911 64 22-256 +49 911 64 22-283
johann.bauer@sunchemical.com

2-COMPONENT INKS

DEFINITION

2-component inks (or 2-c inks) are ink types (=component A) which are mixed with a reactive chemical (=component B - the hardener) prior to processing at a predefined mixing ratio. After mixing the ink/hardener mixture can be processed within a period of several hours (=pot life).

FUNCTION

There is a chemical reaction during which the hardener cross-links with the binders contained in the ink and/or the surface of the printed substrate. On account of hardener addition prints will show better resistances against aggressive chemicals or extended periods of weathering than 1-c inks. On difficult substrates such as glass, metals or pre-treated polyolefines (PP/PE) you can only achieve adhesion using inks mixed with hardeners. Various mixing ratios between ink and hardener depend on intended application, substrates used, reaction properties of the binders and the required cross-linkage. Mixing ratios range from 20:1 (e.g. Z/GL) to 2:1 (e.g. TP 260).

BINDER BASE

Binder systems of screen and pad printing inks are mostly composed of several groups of resins. Depending on the requirements an ink has to meet, the requested properties are achieved by careful choice of special resins and amounts used.

Most 2-component inks of Coates Screen Inks GmbH are solvent based. We also offer a few UV-curing inks where optional addition of hardener will improve adhesion or resistance properties on difficult substrates such as glass, stainless steel or polyolefin materials.

Summary of resins used in 2-component inks and their specific properties

Acrylic Resins

Good chemical resistance.

Very good weather resistance.

Base of ink types ZM, ZMN, TP 305.

Epoxy Resins

Very good chemical resistance and good adhesion.

Limited weather resistance.
Only suitable for indoor use.

Base of Z, Z/GL, TP 218 und 218/GL, TP 260, UV/K.

Polyester Resins

Very high chemical resistance, very good weather resistance.

Formulations with various degrees of hardness or elasticity are possible.

Ingredient of Z/DD, LAB-N 331213.

PUR Resins *(Polyurethane)*

Good chemical and weather resistance.

High abrasion resistance, good elasticity.

Used in ink type TZ.

PVC Resins

Good chemical resistance, good weather resistance.

Part of Z/PVC formulation.

HARDENERS

Hardeners based on polyisocyanate, silane and amines are used for our 2-component ink types.

Isocyanate hardeners are very common. There are many different types of these hardeners (e.g. ZH, ZH/N, ZH/N-00, UV/H). They are suitable for processing with various binder systems.

Silane hardeners (ranges ZH/GL and TP 219/GL) are used for epoxy resin systems in order to achieve adhesion on glass, ceramics, steel or chromium surfaces.

As partial addition to other hardener types amine hardeners are sometimes used.

TYPES OF 2-COMPONENT INKS

2-component inks do not only differ in their mixing ratio between ink and hardener. In addition to ink types, where processing with hardener is essential, there are two other kinds of 2-c inks.

Mandatory 2-component inks

Such inks always have to be processed with hardener.

These are our ink types SVC, Z, Z/GL, ZMN, ZM, Z/DD, TP 307, TP 260, TP 253L, TP 218/GL, TP 218.

Optional 2-component inks

These ink types can be processed without hardener. Hardener addition is possible to enhance properties. Such inks are our products PO, TZ, YN, ZE1690, Z/PVC, 80UV, UVE, UVK, UVGS, TP 247, TP 253, TP 273, TP 300, TP 305, TP 313, TP 340.

Inks curing by heat application - "oven-curing" inks

This special type of 2-component inks can be processed like a 1-component ink. The ink formulation already contains a so-called "blocked" hardener. This hardener will only react under the influence of a certain temperature. Oven-curing inks such as LAB-N 331213, O or TP 212 can be air dried after printing, but have to be oven-cured at 140 - 160°C for a period of 20-30 minutes to fully cure.