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Color & Comfort

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Training

PROCESSING OF 2-COMPONENT INKS

You will always use 2-component inks (abbr: 2-c) when you require screen or pad prints of high physical quality (high light fastness , weather resistance, good adhesion, high abrasion resistance etc.) and/or high chemical resistance on substrates such as glass, metals, duroplastics, polyolefins and similar materials. The required high resistances are sometimes not possible with 1-component (1-c) inks. Compared to 1-c inks, working with 2-c inks is much more demanding. Errors during processing or wrong handling may result in significant quality problems.

In the following article we want to outline important issues of processing (solvent-based) 2-component inks, point out the handling errors causing quality problems, give you information about functions and various versions of 2-component inks.

WHAT IS DIFFERENT ABOUT 2-C-INKS?

1-component inks are (only) adjusted for printing with thinners/retarders prior to printing. They then dry by evaporation of solvents. Then the ink layer is “finished” from a technical point of view.

However, due to their formulations 1-c inks show none or only limited resistances against aggressive chemicals (solvents, acids etc.) The advantage of processing 1-c inks is easy cleaning of any ink dried into stencils and tools with solvents or cleaning agents. To adjust 2-component inks a predetermined amount of reactive 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 is initiated. A print applied with 2-c inks is not “ready” before cross-linkage reaction between hardener and binder is completed. This process takes at least 72 hours at room temperature of 20°C. Only then the prints will show the specific high resistance properties.

The basic requirement always is to follow the instructions regarding processing parameters.

SELECTION CRITERIA

- 2-component system suitable for the specific requirements (see ink charts of Coates Screen Inks GmbH).
- Hardener must be suitable for ink system and requirement profile, e.g.
  - Hardener Z/H only for prints used indoors as this hardener tends to yellowing.
  - Hardener ZH/N also for outdoor use, non-yellowing.
    Mainly for prints onto soft or flexible substrates such as TPU/TPE, synthetic textiles.
  - 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 14 months. 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.

ADJUSTING 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.

Weigh the hardener accurately and stir professionally into the ink.

- Always tightly re-seal opened hardener cans, as hardeners will react with humidity.
- Ink is only thinned and/or retarded AFTER hardener addition.
- We recommend allowing mixed 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 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. This is the reason ink manufacturers will give information about 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.

- 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 much shorter pot life).
- If an ink becomes or remains too viscous 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.

Time frame for overprintability

Printing of multiple layers should be completed within 12 hours. If time periods range from 12 - 24 hours, pre-test 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 continue, 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 of hardener

Every hardener requires a certain minimum temperature for cross linkage.

There will be no reaction with the ink 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 Z/H, TP 219 ≥ 15°C
- Hardener ZH/N, TP 219/N ≥ 20°C
- Hardener TP 219/L ≥ 140°C

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Reaction Time

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

Drying/curing takes place at room temperature of 20°C. Thumb rules for curing times are as follows:

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

Drying/Curing Errors

- No temperature control of substrate.
  The surface of substrates stored at cold temperatures will become humid when brought into print shops with normal temperatures. 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 storerooms 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-component inks can only be obtained 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.

Weigh the hardener accurately and work it carefully into the ink, preferably mechanically, using appropriately powerful stirring devices.

PROCESSING OF

2C-INKS

BASIC-INFO

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. 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 polyolefins (PP/PE) you can only achieve adhesion using 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.

HARDENERS

Hardeners of Coates Screen Inks GmbH are based on poly isocyanates, silane, and amines.

Isocyanate hardeners are quite common and available in various adjustments (e.g. Z/H, ZH/N).

They are suitable for processing with various binder systems. Silane hardeners (ZH/GL and TP219/GL ranges) are used for epoxy resin systems for applications requiring adhesion on glass, ceramics, steel, or chromium surfaces.
Amine hardeners are sometimes used as a proportionate addition to other hardener types.

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 adhesion. Limited weather resistance.
Only suitable for indoor use.
Base of Z, Z/GL, TP 218 and TP 218/GL, TP 260.

Polyester Resins

Very high chemical resistance, very good weather resistance.
Formulations with various degrees of hardness or elasticity are possible.

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.
Used in Z/PVC.

TYPES OF 2-COMPONENT INKS

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

A distinction is made between:

PURE 2-COMPONENT INKS

Processing with hardener is mandatory. These are our ink types Z, Z/GL, ZGM, ZMN, ZM, Z/DD, TP 307, TP 260, TP 253L, TP 318, 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, TP 247, TP 253, TP 273, TP 300, TP 305, TP 313, TP 340, TP 400.

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.