

CerDeCure & the Ferro color series

The extent of cure achievable with a UV paste depends on many factors.

Some are of general nature like conveyor belt speed, lamp power, layer thickness and pasting ratio. The same rules apply to all combinations of ceramic color and medium.

A few examples are depicted below.

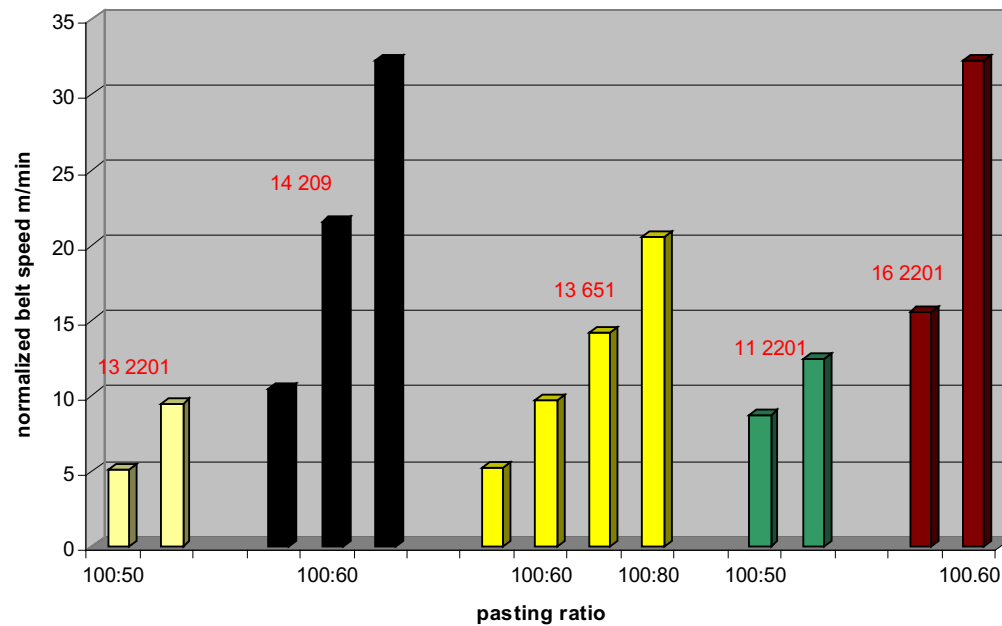


Diagram 1
Correlation UV dose/ pasting ratio

The higher the medium portion of the paste, the faster the cure. As a crude rule of thumb, a dilution of paste with 10 parts of medium when going from 100:50 to 100:60 means doubling the cure speed. Further dilution will accelerate cure to a lesser, but still noticeable extend.

The next chart shows the almost linear decrease of cure speed with increasing layer thickness (depicted by corresponding optical density). A comparison by screen mesh is included for simplification.

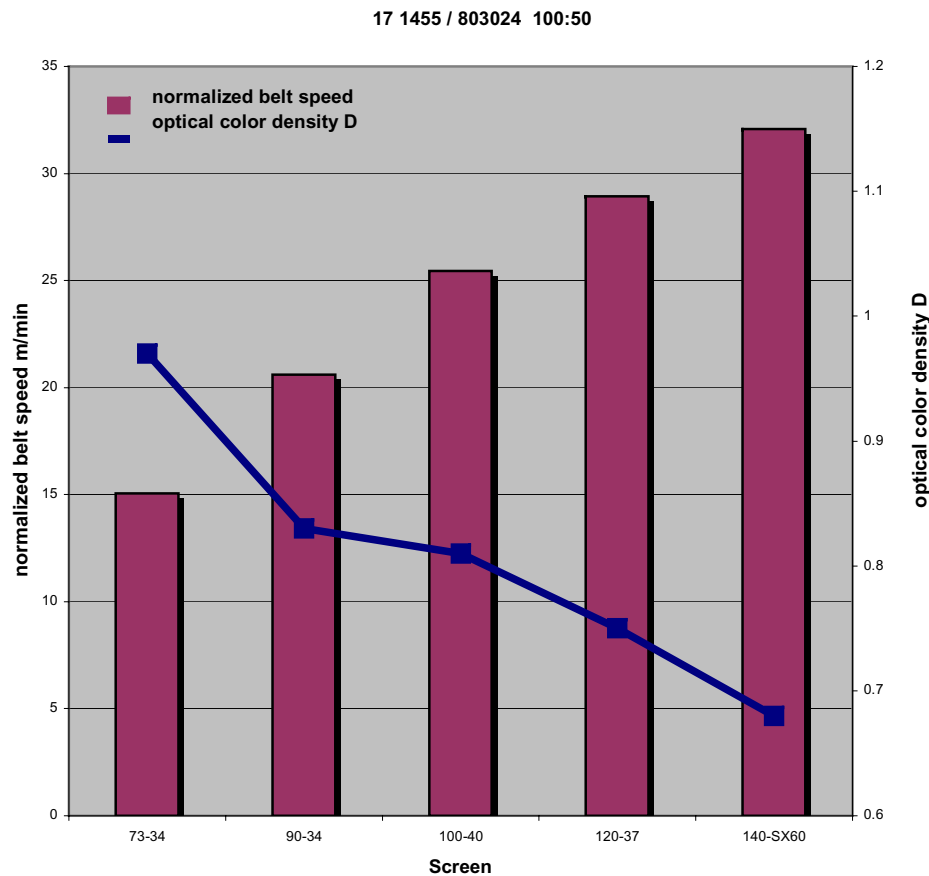


Diagram 2

Correlation of screen mesh / belt speed (optical density corresponding to screen)

Besides these general issues, some are more specific like the absorption of UV light by individual colors, the conversion of UV energy of various wavelengths into hardening the medium and of course, the generation of a certain spectrum by the UV lamp.

The latter may generally be considered as constant as there is no need to change the type of lamp installed in a UV curing unit designed for ceramic decal printing.

The spectral response of Ferro's UV mediums is also largely constant over all products with the exception of mediums that are formulated for use with only one specific color. Such mediums are not commercially available from Ferro, they are used only for ready mixed paste.

The individual UV absorption of the different ceramic colors remains as a variable.

Although there are some rough guidelines indicating that yellow color is difficult to cure whereas cobalt-blues are inherently easy to cure, there are also contradictions to this rule of thumb. In addition, for many colors, no rule derivable from the color tone can be seen.

Ferro has therefore designed a practical reactivity test.

CerDeCure

This test in its standard form is published as a bar chart collection for many of Ferro's color series. The information coming from it is:

Relative reactivity expressed in belt speed units from 0-30 m/min

Brittleness of a multiple print expressed in arbitrary units from 1-3

Viscosity of the paste in Pa*s

This viscosity information is helpful in determining the appropriate pasting ratio for screen printing.

Modifications of the test may be used for gathering data related to the specific needs of individual print shops.

Standard procedure is:

Make a 100:50 paste of each color.

Print through a 90T Polyester mesh a flat surface and a gradient (Single prints and triple prints).

Set drier to 80% power (~ 270 mJ/cm² at 20m/min).

Determine by thumb twist test whether print is sufficiently cured.

If yes, increase belt speed until cure fails, reduce belt speed in smaller increments until cure is ok again> take note of that belt speed value.

If no, decrease belt speed until cure is ok. Increase belt speed in smaller increments until cure fails again. Then go back in ever smaller increments until cure is ok again > take note of that belt speed value.

do a bending test on a triple print after 2 weeks

do a second bending test on a triple print after 2 months

evaluate the gradient in order to determine the printability.

In order to check for covercoat attack, partly (edge) coat each finalized print after 10 minutes. Take note if attack occurs.

The results depicted in a set of 3 graphs/series are to be interpreted in the following way

CerDeCure

1. Reactivity chart

All colors between 10 and 20 m/min are ok with the standard reactivity mediums

Colors from 20-30 m/min should be checked with the low reactivity mediums but can be used with standard reactivity mediums in most cases if UV dose is set to the lowest level providing sufficient cure.

Colors below 10m/min should be checked with the high reactivity mediums, in most cases these will be the better solution.

If UV dose is varied, changing the belt speed is preferred over changing the UV power since the latter has a slow response and can only be varied within narrow margins without altering the spectral output of the bulb. Of course, printing speed sets the low margin for the belt speed. (keep 15 cm distance between sheets)

2. Flexibility chart

- 2.1 Colors with initial value of 1 and long term value of 1 are ok with the standard mediums, high reactivity mediums may be evaluated, if necessary
- 2.2 Colors with an initial 1 and a long term 2 are ok with standard medium for immediate use; for long term storage, a low reactivity medium should be considered
- 2.3 Colors with an initial 2 and long term 2 are ok with standard mediums for immediate use in low thickness; for thick layers and if storage is an issue, low reactivity mediums should be considered.
- 2.4 Colors with initial 2 or 3 and long term 3 are strongly recommended to be tested with low reactivity medium. Only for thin layers, may a standard medium be acceptable.

It is important to keep in mind that UV prints for the time being are overprinted with conventional, solvent containing covercoat with all known implications on decal shelf life.

3. Viscosity chart

- 3.1 All colors between 4 and 8 Pa*s print well at 100:50
- 3.2 Colors above 8Pa*s should be printed at a 100:50+ ratio
- 3.3 Colors below 4Pa*s print well at 100:50- ratios. However, including more color into the paste means lowering the reactivity. It is not useful to do this with paste showing below 20 m/min belt speed in the reactivity chart. In that case, it is better to replace some of the medium with UV thickener to get a more viscous paste at identical pasting ratio. Alternatively, high reactivity medium may be used.

CerDeCure**4. General remarks**

There are multiple ways of getting the right cure for each print job.

- 4.1 Choose the suitable medium for each job based on above principles. Vary machine settings (belt speed, lamp power) only if inevitable.
- 4.2 Adjust machine settings for each job based on test prints. Vary the medium only if inevitable.

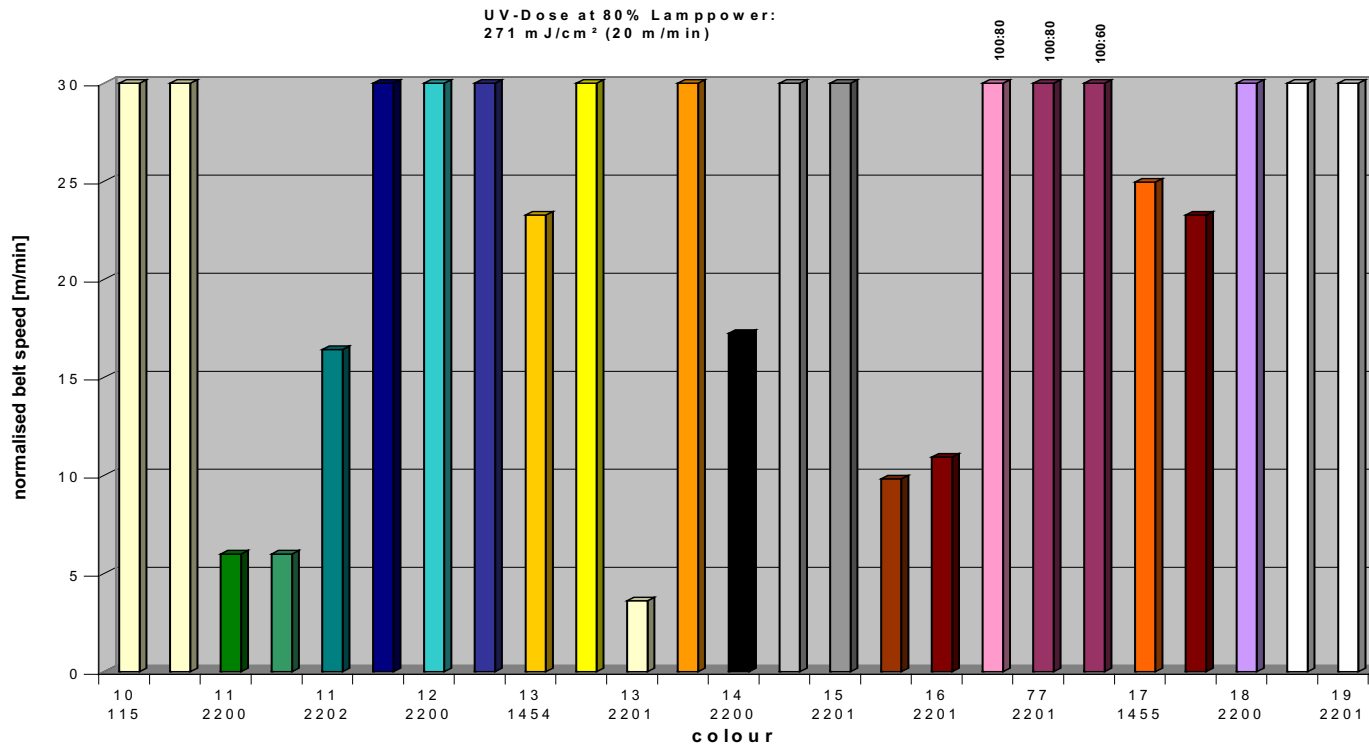
When using the method described in 4.1, all three series of mediums will be used. One should always try to use as much low reactivity medium as possible since this is the best way to avoid brittle decals.

To proceed as described in 4.2 requires some experience in UV printing. Statistics show that around 80% of all prints can be cured with the standard mediums. Frequent UV dose checks as well as timely lamp replacement are mandatory.

CerDeCure & the Fiesta Palette

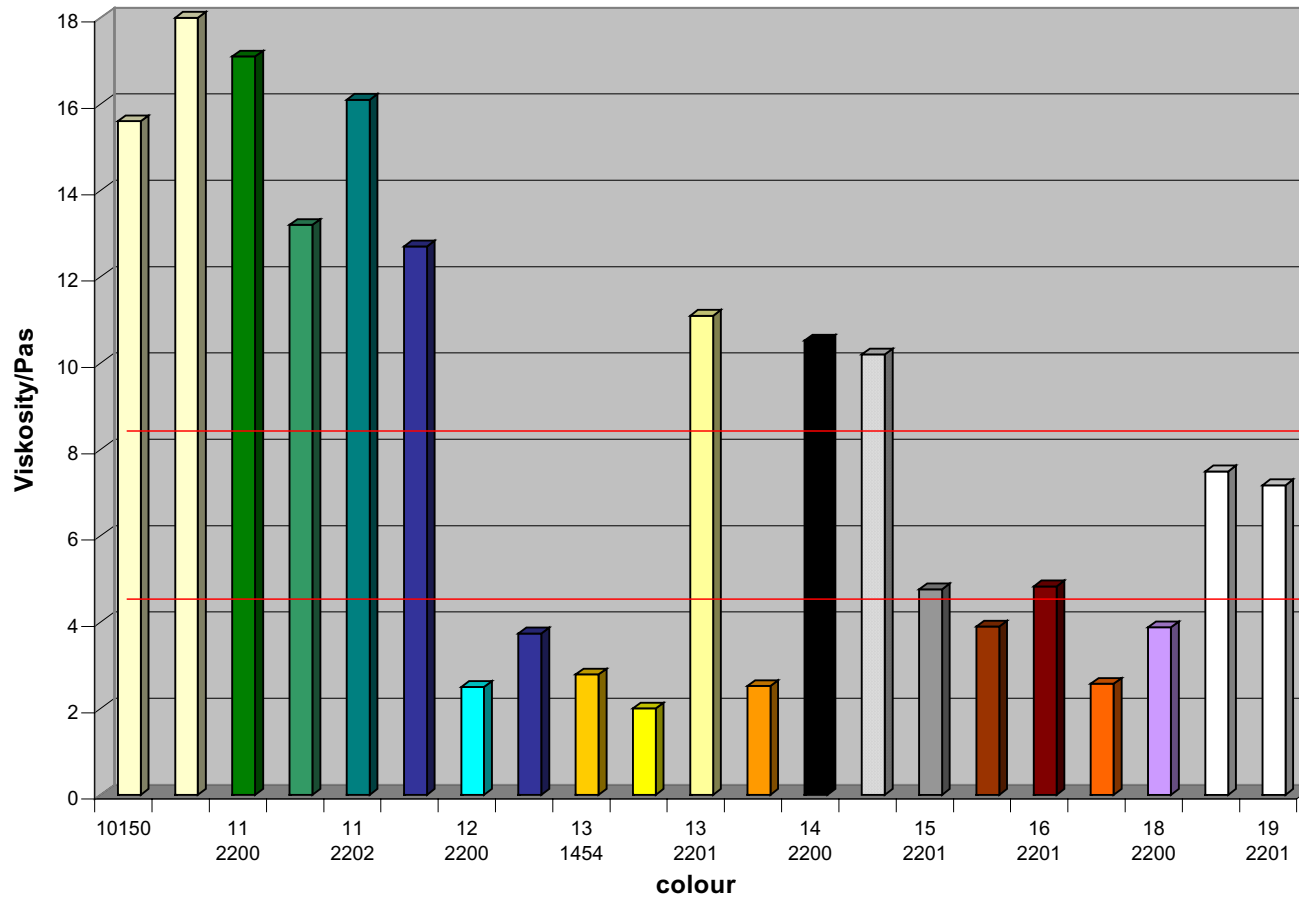
Standard Test based on 803024 (1:1 mix of 803022:803023)

Reactivity Chart



Viscosity Chart

Viscosity under shear (D 200) of Fiesta pastes at pasting ratio 100:50 /803024



CerDeCure

Test**Parameters:**

- **Reactivity:** Print 100:50 paste with 90-34 Polyester screen. Evaluate cure by thumb twist test
- **Flexibility:** Bend triple print after 2 weeks and 2 months.
 - 1= no crack,
 - 2= crack after sharp bend only
 - 3 = crack after slight bend

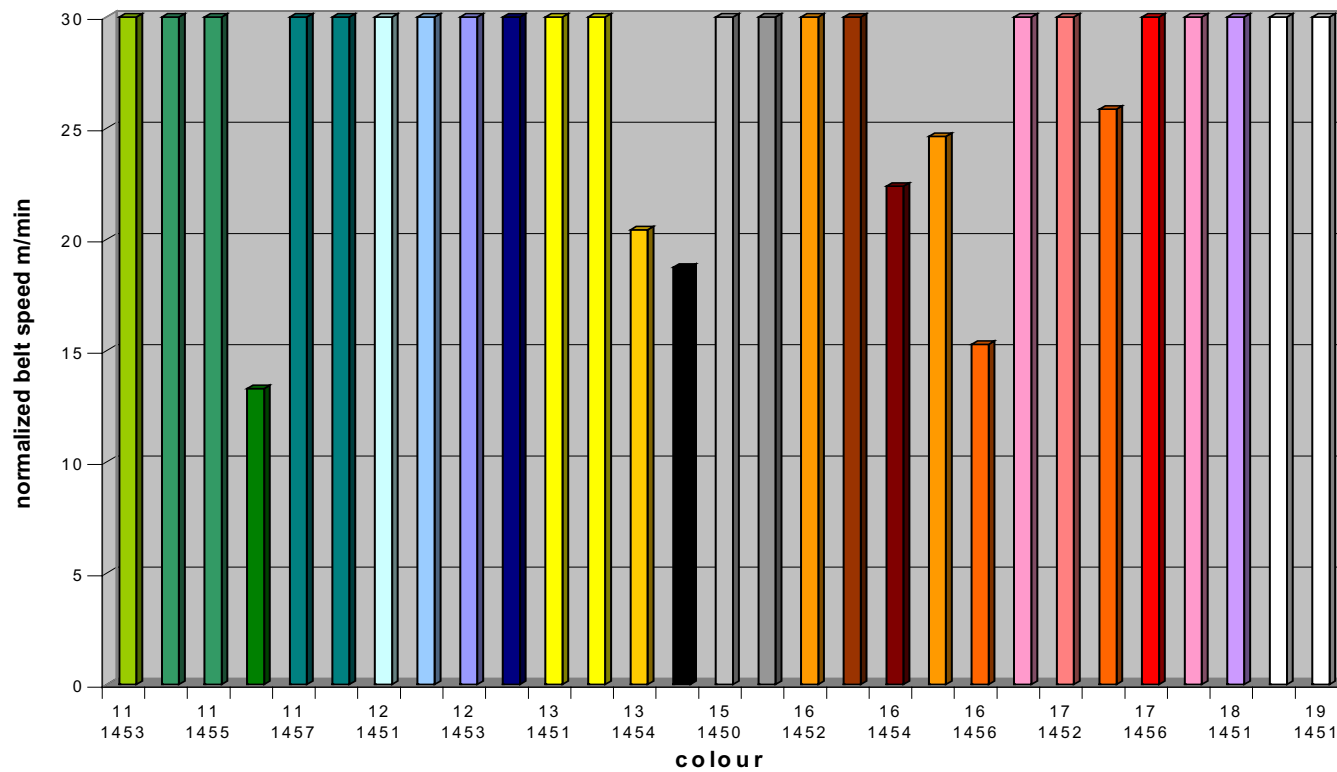
Viscosity: 100:50 paste at 23°C. Shear = 200/s. Cone & plate rheometer.

CerDeCure & the Impression series

Standard Test based on 803024
(1:1 mix of 803022:803023)

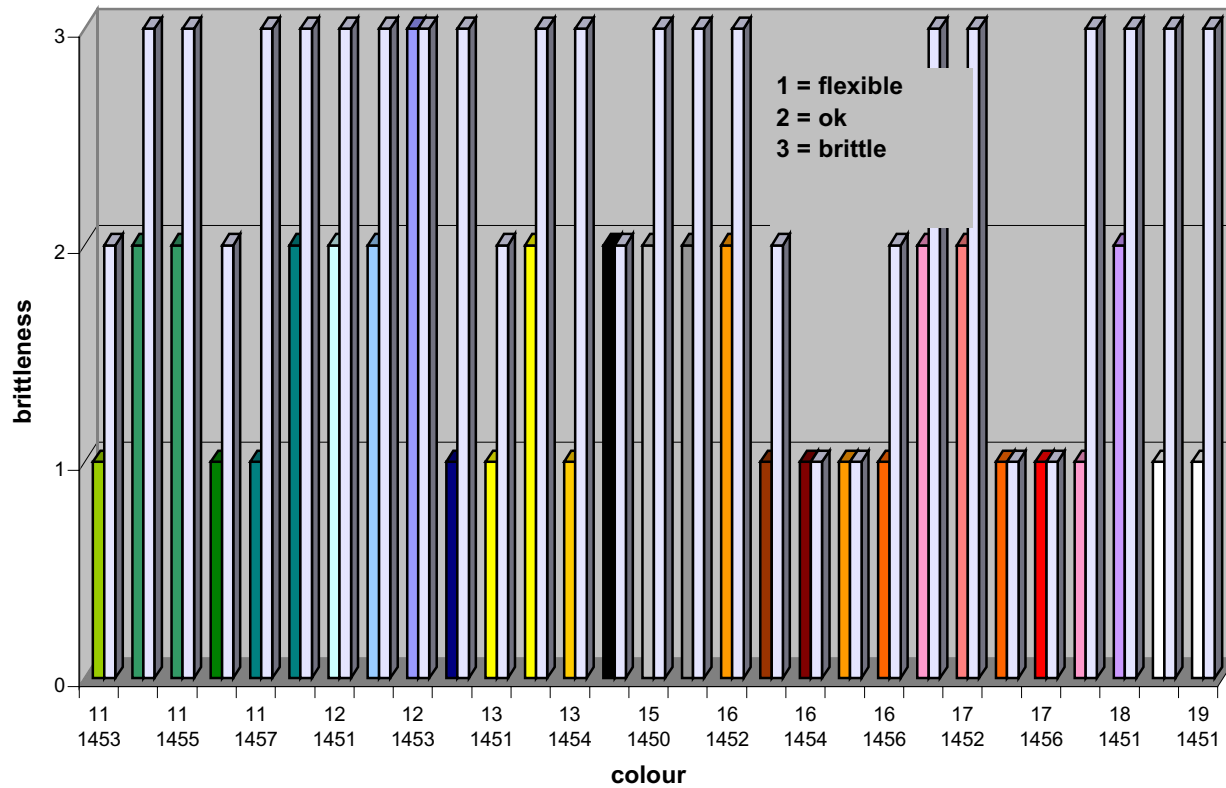
Reactivity Chart

UV-Dose at 80%
Lamp power
271 mJ/cm² (20 m/min)



CerDeCure

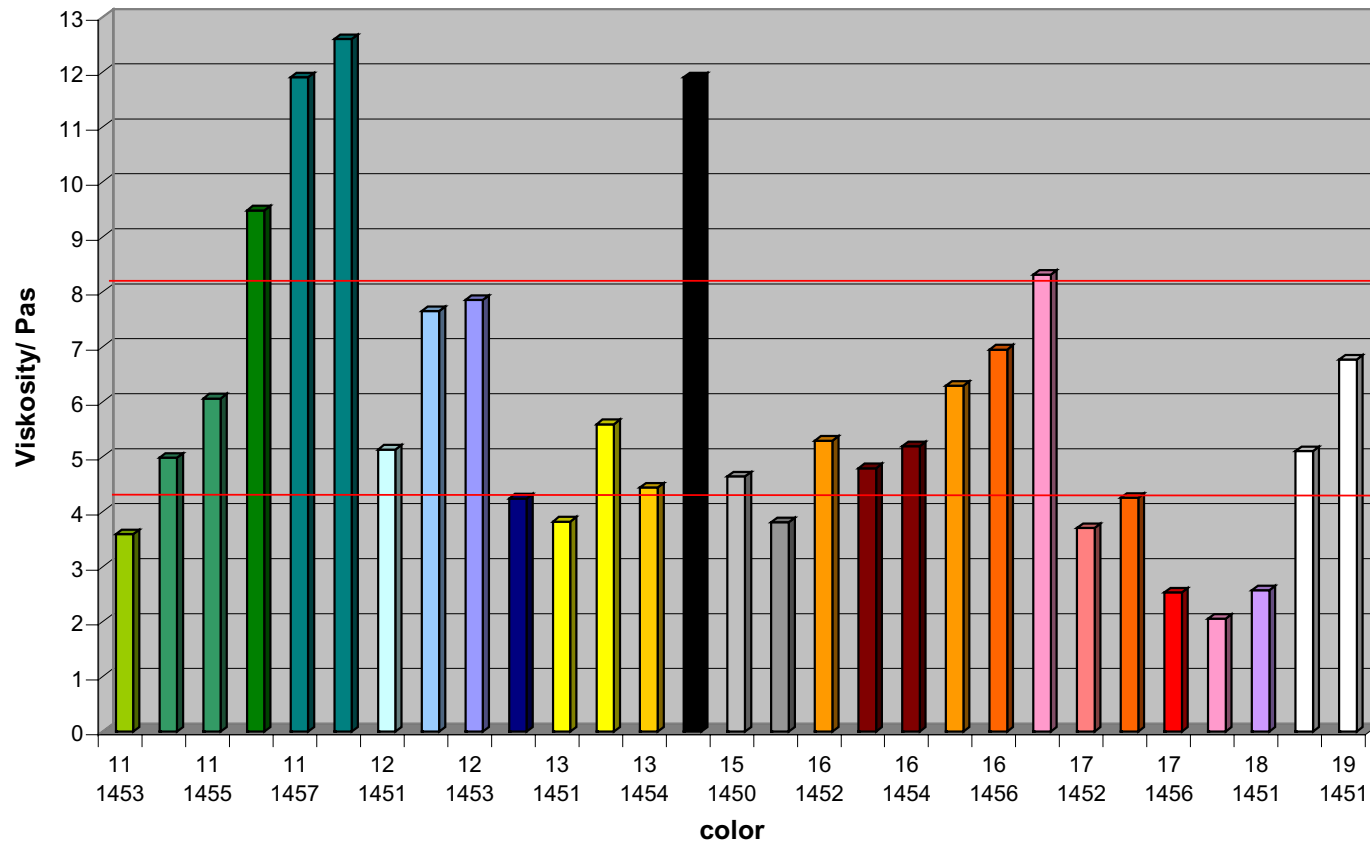
Flexibility Chart



CerDeCure

Viscosity
Chart

Viskosity under shear (D 200) of Impression pastes
at pasting ratio 100:50 /803024



CerDeCure**Test**

Parameters: Reactivity: Print 100:50 paste with 90-34 Polyester screen. Evaluate cure by thumb twist test

Flexibility: Bend triple print after 2 weeks and 2 months.

1= no crack

2= crack after sharp bend only

3= crack after slight bend

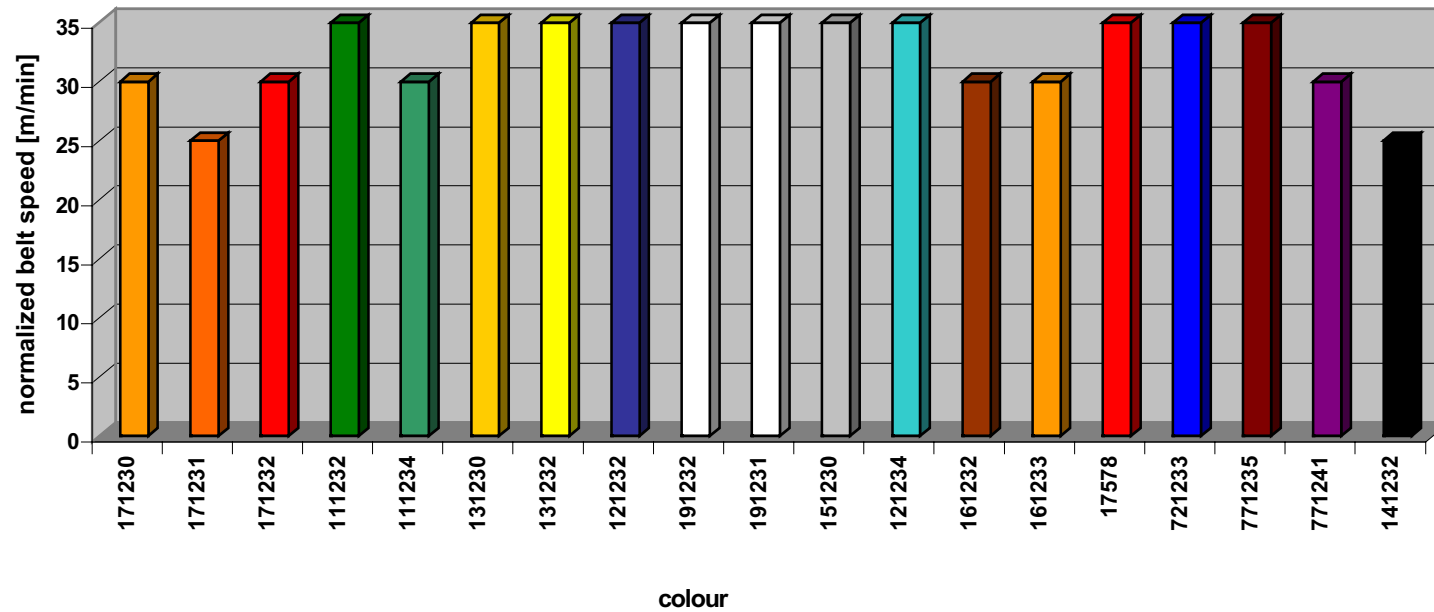
Viscosity: 100:50 paste at 23°C. Shear = 200/s. Cone & plate rheometer.

CerDeCure & the Sunshine series

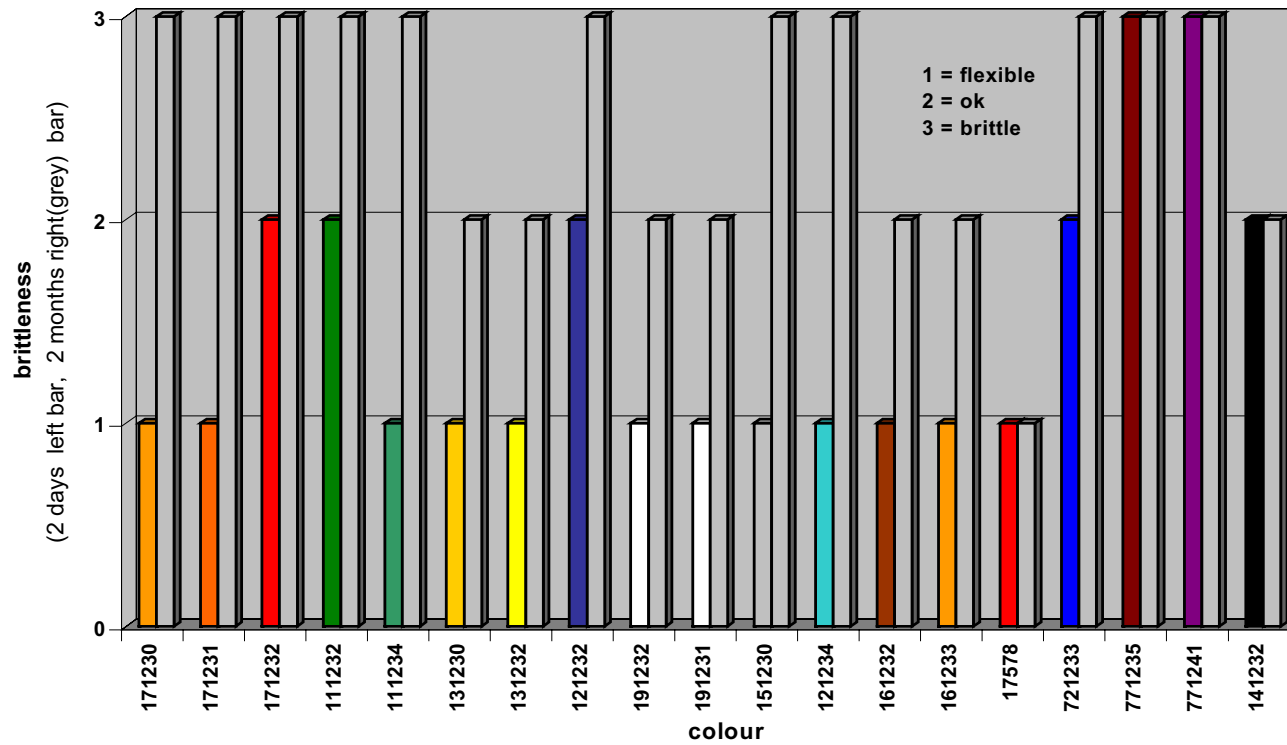
Standard Test based on 803024
(1:1 mix of 803022:803023)

Reactivity Chart

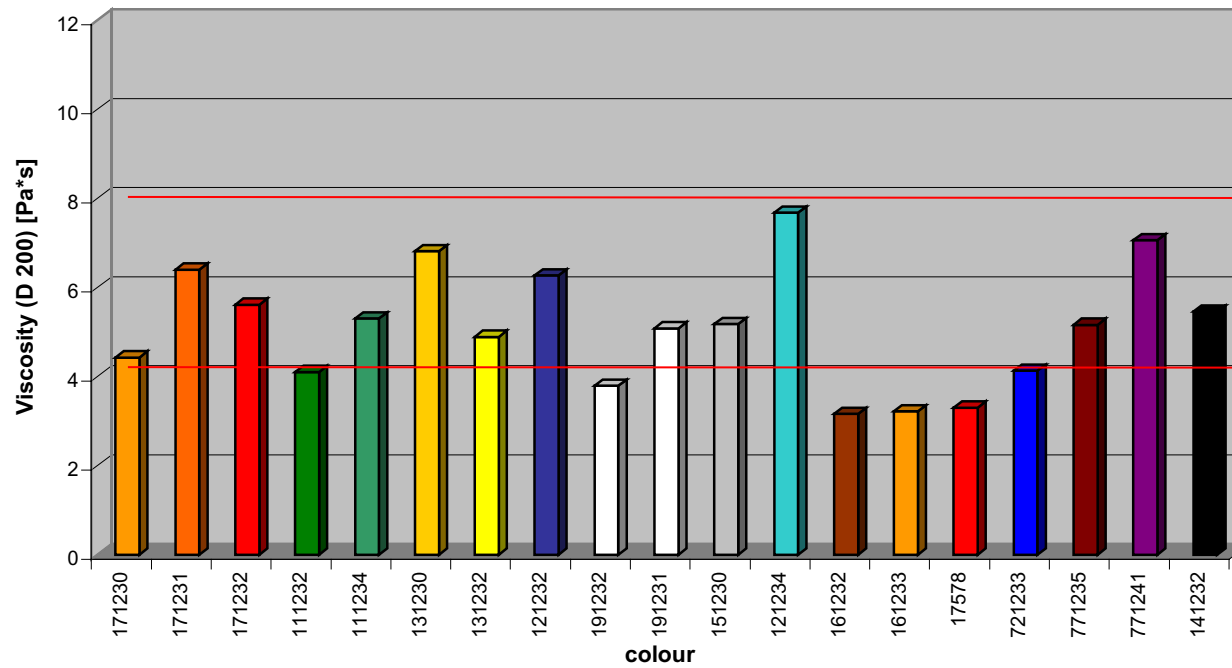
UV-Dose at 80% lamp power:
271 mJ/cm² (20 m/min)



Flexibility Chart



**Viscosity
Chart**



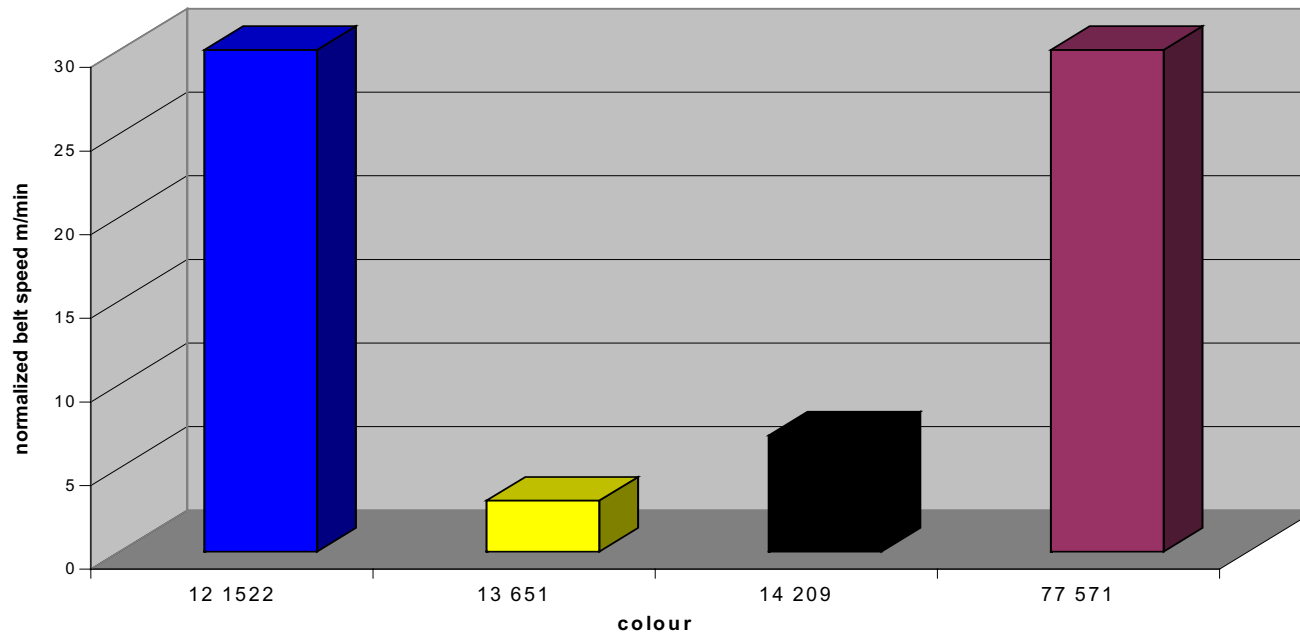
Test**Parameters:**

- **Reactivity:** Print 100:50 paste with 90-34 Polyester screen. Evaluate cure by thumb twist test
- **Flexibility:** Bend triple print after 2 **days** and 2 months.
 - 1= no crack
 - 2= crack after sharp bend only
 - 3 = crack after slight bend
- **Viscosity:** 100:50 paste at 23°C. Shear = 200/s. Cone & plate rheometer.

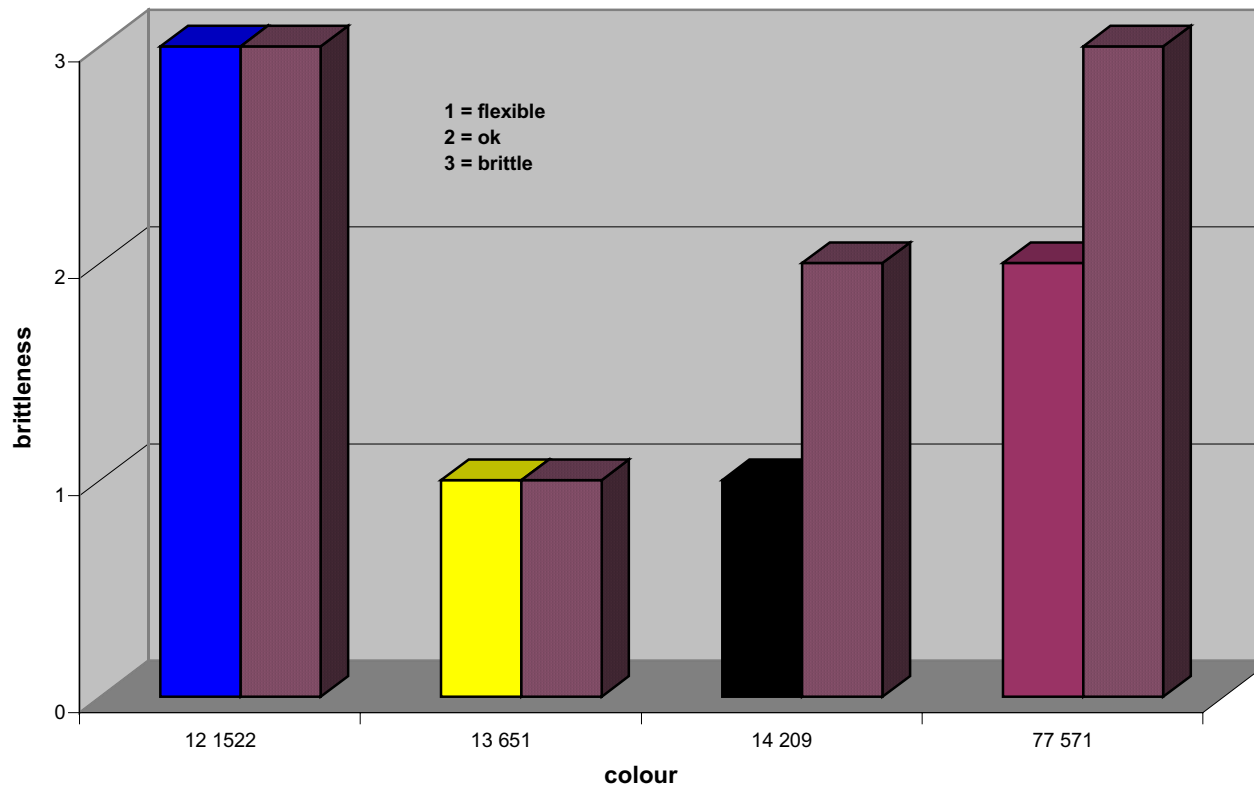
CerDeCure & the CerDeChrom 4 color set

Standard Test based on 803024
(1:1 mix of 803022:803023)

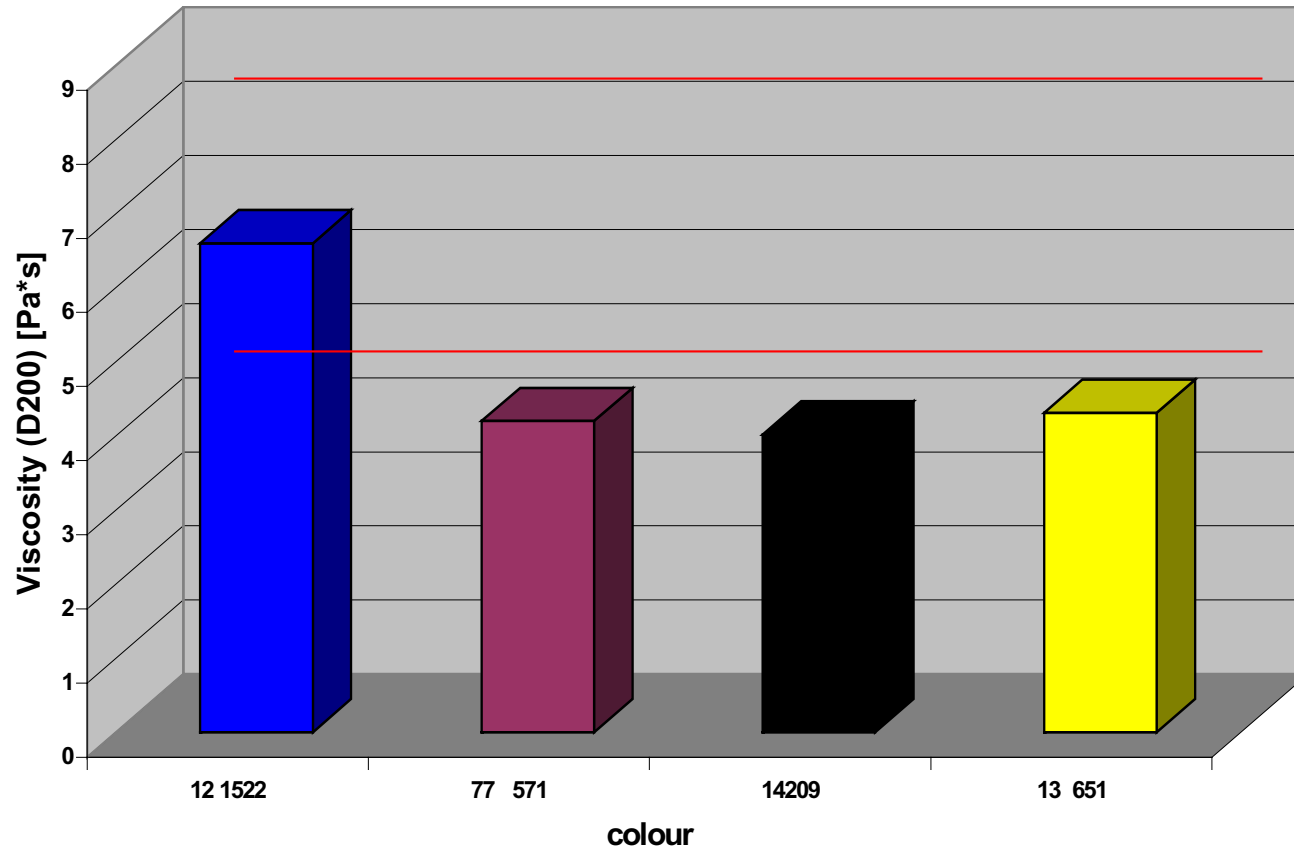
Reactivity Chart



Flexibility Chart



Viscosity Chart



CerDeCure

Test**Parameters:**

- **Reactivity:** Print 100:50 paste with 90-34 Polyester screen. Evaluate cure by thumb twist test
- **Flexibility:** Bend triple print after 2 weeks and 2 months.
 - 1= no crack
 - 2= crack after sharp bend only
 - 3 = crack after slight bend
- **Viscosity:** 100:50 paste at 23°C. Shear = 200/s. Cone & plate rheometer.

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