

# Application field of LED UV based screen printing inks onto glass

George Koch, Technical Support - RUCO Druckfarben, Germany

150 years creating the future.

20.09.2013



## **Application field of LED UV based screen printing inks onto glass.**

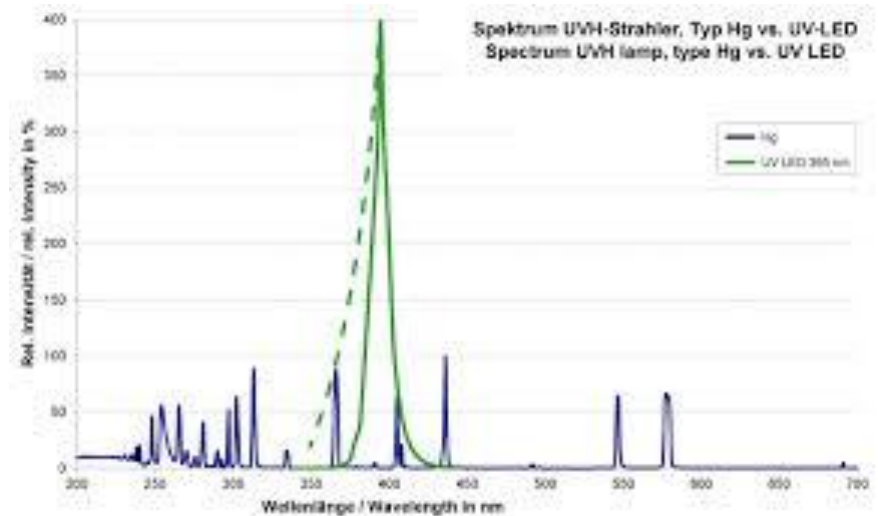
Benefits compared to conventional UV curing systems.



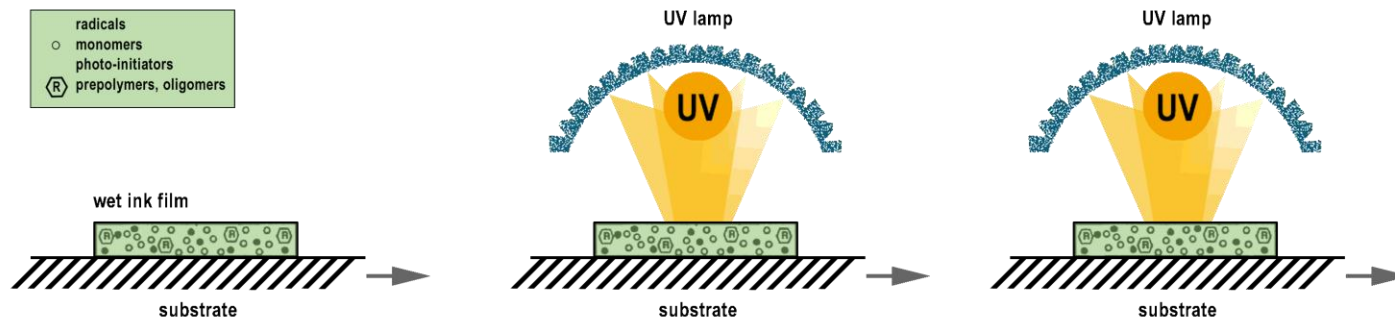
## Spectrum of LED UV compared to UV-C and UV-B

Conventional UV bulbs like Mercury vapor or Iron dot. bulbs are curing UV inks within a spectrum in UV C and UV B.

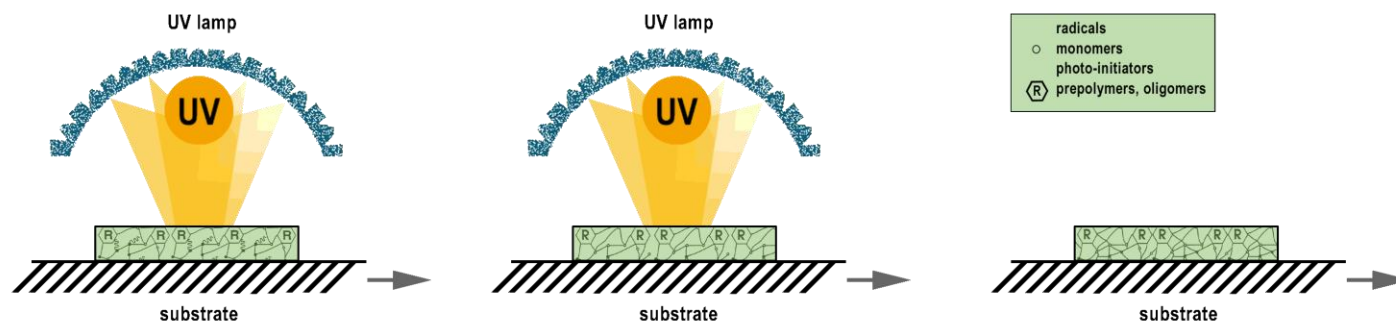
X-Rays	UV	VIS	IR
180 nm	280-350 nm	420 nm	
UV-C	UV-B	UV-A	



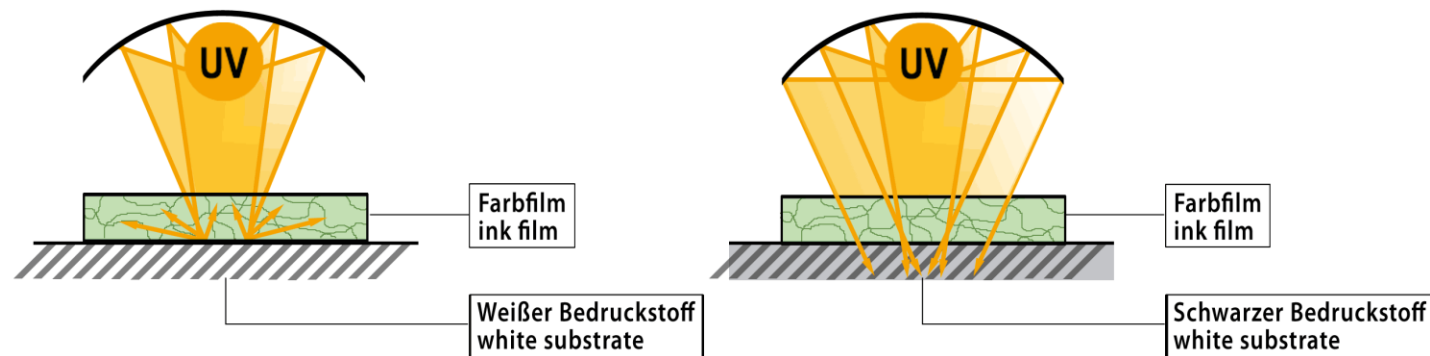
LED modified UV inks are containing additional photo initiators where we have primarily a chemical reaction in the long wave length of the spectrum



LED modified UV inks are containing additional photo initiators where we have primarily a chemical reaction in the long wave length of the spectrum.



With the LED UV curing system we can achieve a very good depth curing which gives us a better adhesion onto the glass surface directly after the printing and curing process



## **LED Hybrid UV curing systems**

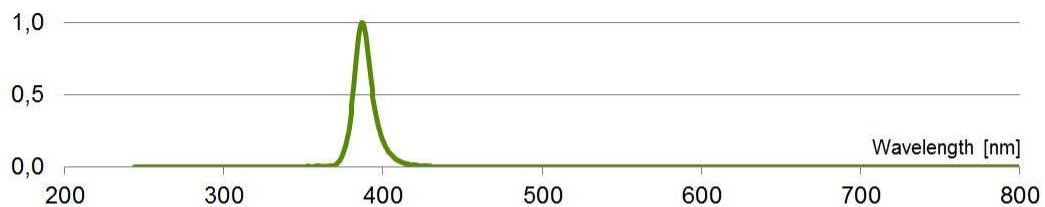
When using LED UV curing systems there are two possibilities either using only UV LED bulbs for curing the inks film or in combination at the end using UV-C-bulbs to achieve an excellent surface durability.

UV LED inks are normally formulated as a “hybrid version”, that means to be very flexible if we have only LED curing or using a combination between LED UV and UV-C.

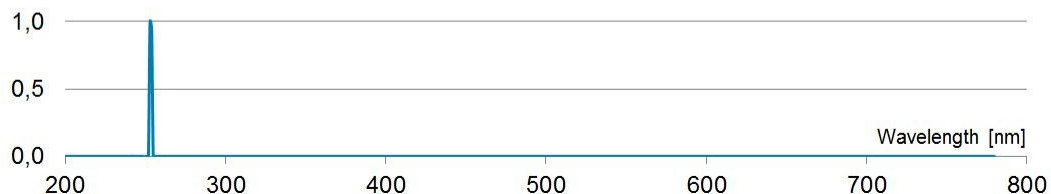
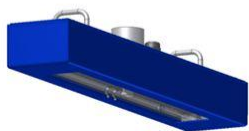
At the moment there are LED bulb system with 4, 8 and 12 W/cm available

## Spectrum: LED Hybrid UV curing system:

NobleCure<sup>®</sup>  
(UV-LED)



UV-C Cure





## **Process certainty when using LED curing inks systems onto glass**

### **What does this mean ?**

When using conventional UV based we have a posturing process which means normally we have to wait between 24 and 36 h until we are able to do the final cross hatch test to be sure that the pre-treatment of the glass surface was good and we can achieve a perfect adhesion

When using UV LED inks we can achieve this result within a much shorter time.

## **Process certainty when using LED curing inks systems onto glass**

### **What does this mean ?**

That gives us a much better process certainty during the production

Now we are able to control the printing quality directly after the UV curing process which has an advantage.

## Durability characteristics:

### - Testing the adhesion onto the glass surface: Tape test

One of the most popular testing methods for adhesion is the tape test (Scotch Test Tape 600). After the printing and curing process we can use this testing method. With conventional UV curing inks this test cannot be performed until 24 or 48 h after curing due the fact, that this UV curing inks have a post curing time.

With LED curing inks we can achieve such kind of adhesion within a much shorter time.



## **Durability characteristics:**

### **- Testing the adhesion onto the glass surface: Cross hatch test**

#### **DIN EN ISO 2409 ASTM D 3002**

Another testing method is the cross hatch test which tests the level of adhesion. Normally when using UV based inks for the decoration onto glass we can achieve a result between GT 0 and GT 1.



## **Durability characteristics:**

### **-Testing method: wipe resistance**

#### **DIN EN ISO 1198 elcometer k 1720**

This testing method is based on rubbing with a weight of 500 g within a speed of 37 cycles/min (ASTM D 4828). Used in combination with the ingredients of cosmetics we are also able to test the chemical resistance under controlled conditions.

This level of high durability is also necessary when packaging directly after the printing and curing process.



## **What durability characteristics can we expect with LED UV based inks?**

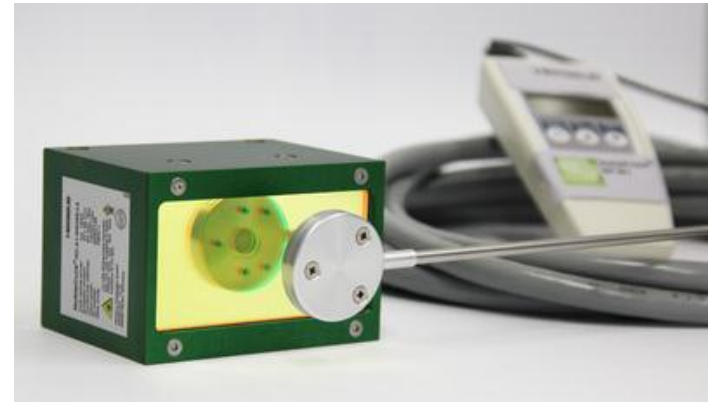
Before talking about the durability of the decoration onto glass we should ask if it makes sense to do a scratch test with a “knife”. For many years this made sense when considering that ceramic inks melted into the surface of the glass, with LED UV inks which bonds to the surface, does this still make sense? So let us find a realistic compromise when testing UV based inks and comparing the results with ceramic inks - not using a knife.

The paint on your car is incredibly durable, yet you would not use a knife to test it – it is the same with UV printing inks.



## UV light density testing methods:

Earlier we have spoken about adhesion, but first of all we must talk about the UV curing of the ink. If the UV light intensity is very low, we do not have a very good chance to achieve good adhesion, so we must first test the intensity of the lamps. To do this we can use a UV light intensity integrator



Further information concerning these test procedures can be found in the technical data sheets of the supplier.

## Application field of LED UV curing inks::

### - Beverage bottles

In this application area the UV based ink has to fulfil the following requirements:

- » good adhesion with scratch resistance
- » good water and alcohol resistance





## Hollow glass:

### - coated glass bottles

These types of coatings are used for beverage bottles (like wine bottles etc.) The requirements are as follows:

- » good adhesion and scratch resistance
- » good water and alcohol resistance
- » good wipe resistance during the filling process



## **Hollow glass:**

### **- coated glass bottles**

Compared to the beverage and the the cosmetic sector there are some further requirements and quality demands:

- » Solvent based coatings
- » Water based coatings
- » Powder coatings
- » UV spray coatings



## Hollow glass:

### - Glass packaging for cosmetics

Compared to the beverage sector in the cosmetic sector there are some further requirements and quality demands:

- » good adhesion and scratch resistance
- » very high chemical and product resistance
- » possibility of hot stamping on top of the ink film



## **Hollow glass:**

### **- Drinking glasses**

In this application area the UV based ink has to fulfil the following requirements:

- » good adhesion with scratch resistance
- » excellent dishwashing resistance
- » good water and alcohol resistance



## **Drinking glasses:**

### **- Dish washing trials**

For the “Dish Washing Resistance” the following testing methods are standard:

- » Home dishwashing resistance
- » Industrial dishwashing resistance



## Flat glass application:

In this application area the UV based ink has to fulfil the following requirements:

- » good adhesion with scratch resistance
- » high opacity of the ink film
- » high chemical resistance



## **Flat glass:**

- mirrors, printing (screen) for slot machines (reverse printing)**

Mostly UV based inks are printed reverse on to the flat glass substrate.

Flat glass has two different kinds of surfaces. We call it gas-side and float glass side. The best results are achieved when using UV based inks for the decoration is to print onto the gas side.

Otherwise the tin oxide on the float glass side will reduce the adhesion.



## Flat glass:

### - mirrors, printing (screen) for slot machines (reverse printing)

Especially when producing mirrors it's necessary as the UV based ink film must survive the "mirroring process". This testing requirement is sometimes required in the flat glass industries to fulfil their high quality standards.

- » good adhesion and scratch resistance
- » very high chemical and product resistance
- » high condensation water resistance

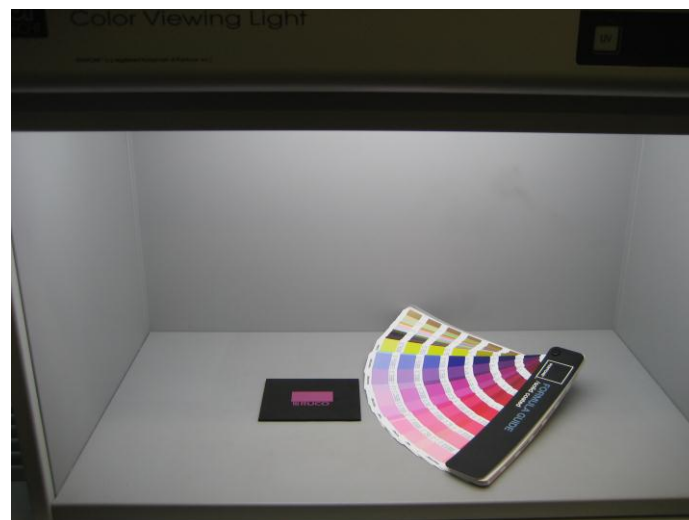




## 12 Color mixing system:

When compared to the ceramic inks that must be high heat cured to see the final colour, UV LED based inks can be evaluated directly after the UV curing process to check the accuracy of the colour.

To maintain a consistent comparison value it's recommended that a light box be used, where we always have the same light conditions to compare the colours.



## Durability characteristics:

### -Testing method: Colour measuring

Another testing method is to use a photo spectrometer where we can measure the colour exactly using a quantitative measurement.



## **The influence of the hot end coating on the quality of the decoration**

- Cold end coatings like: RP 40 , RP 40 LT, 702, T 5, animal fat

In the beverage industries, cold end coatings are used to achieve a very good slip characteristic during the filling process, for example - beer bottles.

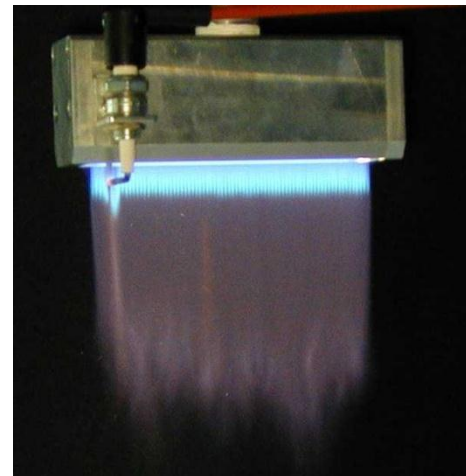
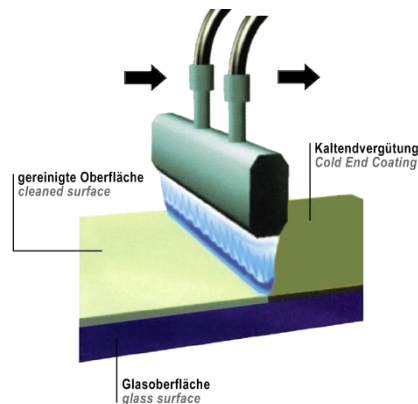
The formulation of these cold end coatings is based on “PE”. These cold end coatings may interfere with the adhesion of UV based inks, so generally, it is necessary to remove this coating prior to the decoration. Optionally, a special flame pre-treatment may be used – we will return to this subject later.



## Flame Pre-treatment:

### - The influence of Pre-treatment before the printing process

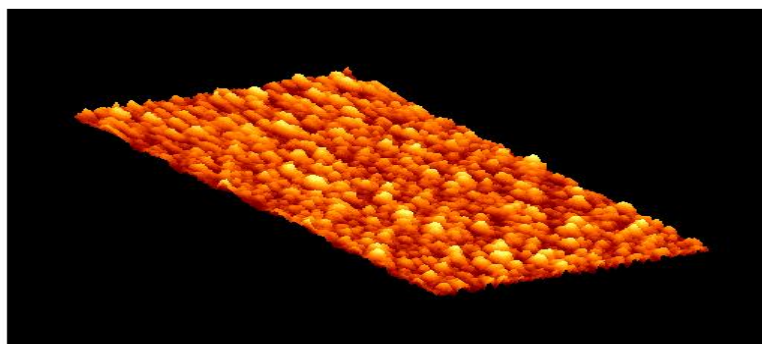
As mentioned earlier, if the glass surface has a cold end coating it's necessary to use a special flame pre-treatment. The best way to achieve the adhesion and scratch resistance when using UV based inks is first to have a standard flame pre-treatment and then later on a silicate flame pre-treatment.



## **Flame Pre-treatment:**

### **- The influence of Pre-treatment before the printing process**

During this process, first we are trying to remove the cold end coating and later, we are applying a silicate coating which has the function of a primer. (see picture) which will result in perfect durability characteristics.



## **Benefits when using “LED curing technologie:**

- » higher ink film opacity based to the advantage of better depth curing
- » application in the packaging glass sector with high speed requests
- » instant possibility to pass a cross hatch test directly after the curing process
- » Smaller size of the UV units in multicolor printing machines

## Conclusion:

We have touched upon the most popular topics according using UV LED technology for the application onto glass.

The use and application of the conventional UV printing process or UV LED printing process cannot and is not designed to replace the use of ceramic inks 100%. However in many cases “UV LED Curable inks” can provide a suitable alternative, with environmental benefits and new and unique decorating opportunities.

A lot of thanks for your attention.