FLAAR Reports

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# Printing on Glass, Acrylic, MDF, Faux Ceramic, ABS+PC


# Primers, UV Printing & Top Coatings


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# Primers, UV Printing & Top Coatings

## Printing on Glass, Acrylic, MDF, Faux Ceramic, ABS+PC

Since UV-curing technology began to be used in inkjet printers in the late 1990's, signage has been the main application target.

The quantity of UV printer manufacturers has been constantly growing to the point that as of 2009 there are more than 45 UV printer manufacturers (not counting the OEM companies that sell printers somebody else built and the many Chinese companies that seem to sell the same printers with different colors). FLAAR makes efforts to keep an updated list of all of them.

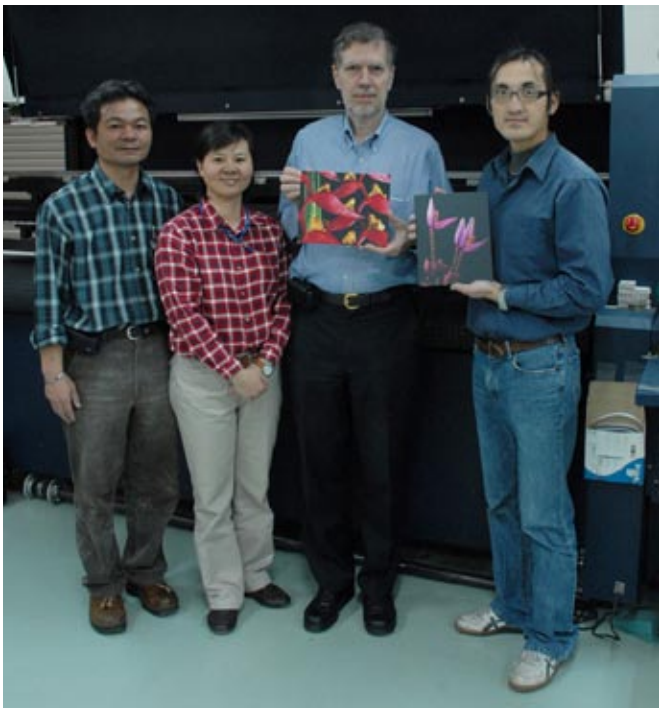

*SGIA '08 trade show. These kind of exhibitions are crowded with manufacturing companies of wide-format inkjet printers, most of which are meant to print signage.*

The signage market for UV printers—and for wide-format printers that use any other technology in general—is getting overcrowded. As time goes by, it becomes more difficult to try to market wide-format printers whose only function is to print signage. This is why printer manufacturers and their R&D departments are beginning to find alternative applications to reach potential customers in non-traditional niche markets.

UV-curing technology has found acceptance in interior decoration and architectural material markets. The applications in this segment are widening and becoming very popular, not only in western countries but also in regions where tradition and culture find a means of expression in the decorative elements, such as Asia, the Middle East, etc. Printing on plastics such as polypropylene is also becoming a significant market (especially for packaging). Glass is very popular in China and other countries in Asia.

*Ceramic tile printed on with a GCC StellarJET 250UV.*


*Table top printed on with a WP Digital Virtu RS35, ISA '09.*



*FLAAR visited the sign shop in Taiwan to inspect the GCC StellarJET 250UV. The ceramic tile you see at the left was primed before being printed on. At right, Nicholas Hellmuth and **Print in One** sign shop staff.*

But it is not that simple. Many companies have attempted to print on ceramic tiles and glass with the same technology they would use to print on foam board or a piece of wood and it hasn't been successful in terms of ink longevity; to sum up, it just peels off. Although UV range of applications is much more than that of solvent ink, the claims of some companies that their UV machine prints on everything should be taken with a grain of salt.

In 2008, FLAAR visited one of the most respected UV printer manufacturers in the industry and unfortunately one of the floor tiles printed by their UV flatbed did not survive. On behalf of the company I must admit the floor tile was, by mistake, exposed to a source of heat (was put on top of a house toaster oven) and the ink layer began to peel off (completely). At FESPA '09, another thriving company that has been gaining reputation for their UV printers, exhibited some samples printed on mirrors, but the samples just didn't pass FLAAR test of scratch resistance.

This is why, until UV ink technology improves in this aspect, treating the media becomes a must, at least for these kinds of materials with smooth or slippery surfaces.

Pre-treatment and post-treatment processes (top-coating) are becoming known in the industry, however, it becomes necessary to know all of the terms and jargon of these steps of the printing workflow. This is why here we provide an introductory Glossary of Treatment for UV Applications.

*This floor tile printed on with a dedicated flatbed did not get the adequate pre-treatment. Imagine you print 1000 floor tiles for a thematic park in Florida without being aware of the need of treatment!*

# Glossary of Treatment for UV Applications

**Abrasion resistance,** although in theory you "can print on anything", some UV-ink on several kinds of surfaces has trouble resisting abrasion to the surface of the printed material. Abrasion can come from being stacked, from being moved, from being cleaned. Scratches are a form of abrasion. If you handle the print with long fingernails, it may or may not result in a visible scratch across the surface. Also known as rub resistance or scratch resistance. See also chemical resistance (solvent resistance).

**Adhesion,** refers to the length of time ink is able to adhere to the material it is printed on. When adhesion is bad, the ink begins to flake off. Certain inks and certain materials have more adhesion issues than other inks on other materials. To improve adhesion on many materials you may need to use a primer.

**Corona treatment** is a pre-treatment that aids the surface tension of polypropylene and other plastics in accepting the UV cured ink, meaning it increases ink adhesion to the surface. For example, polyethylene and polypropylene have nonporous surfaces with low surface energy that result in a poor ink adhesion capability. Corona treatment is a procedure that raises the value of surface energy of materials. Surface energy is measured by Dynes. As a general rule, the Dyne level of the substrate has to be at least ten points higher than the liquid being applied. Unfortunately corona treatment "wears out" so the material has to be used while the corona treatment is still fresh.

**Flame treatment** means literally to pass a flame over the surface of a plastic such as polyolefin, or glass, so an ink will adhere better to the oxidized surface material. You can treat the surface of a plastic chemically, with a flame, or electronically (corona treatment) (www.all-pak.com/plasticgloss.asp?navid=42). Or, you may need to flame treat AND prime a surface before printing (again, glass)

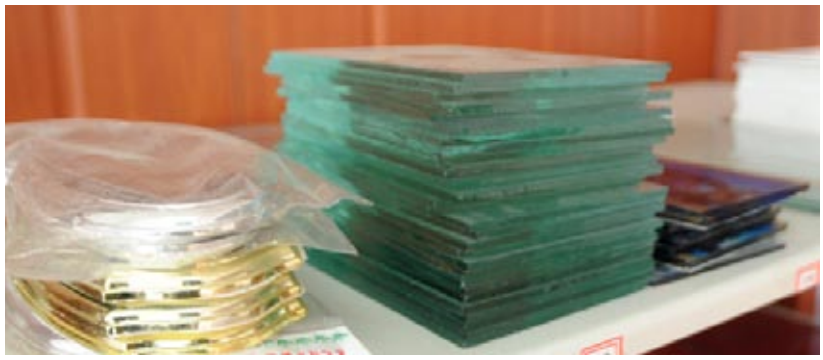
**Media** is material that has been coated with an inkjet ink receptor coating. This kind of ink receptor coating is not necessary for UV cured inks, although you may still need special surfaces and/or a pre-treatment of surfaces. See also, corona treatment, flame treatment and substrate.

**Overcoat** is the top coat of preservative on top of a print. However, in some rare cases, it appears to be an additional ink receptor layer on top of the undercoat. See also undercoat.

**Polyester** is a material that needs to be pre-treated (corona or flame) before some inks will adhere well to the surface.


*You can check the abrasion resistance yourself by scratching a print sample.*

*Adhesion depends on many factors like ink chemistry, type of media, exposure to heat, abrasion, etc.*



*Media is any material that will be printed on. Glass usually requires treatment so that the ink will adhere to its non-porous surface.*

**Pre-treatment**, usually means adding a primer which serves like an ink receptor coating. The difference is that a primer for UV-cured workflow is usually to help the ink adhere, not to interact with the ink to generate a desired color gamut or surface appearance. A primer coating is not usually needed for a UV-curable type of ink other than glass and comparable smooth or slippery surfaces. Pre-treatment for a UV-curable printer may entail first cleaning the surface so there is no dust or oil.

**Primer,** see pre-treatment. A few printer manufacturers are sneaky about priming their rigid boards the day before the show (so the end-user does not know the material has to be primed). Priming takes time, and is an additional expense. The Fuji Acuity has a barely noticeable footnote that warns you that some materials require priming with Sericol "adhesion promoter" before they can be printed with the Oce 250 or corresponding Fuji Acuity printer. Some observers report that some Sericol or Oce booth personnel are priming boards before the trade show starts and may not be telling printshop owners about this issue.


*Primer container for the LexJet Legend 72HUV.*

**PU coating** helps when printing textiles with UV-curable ink. PU = polyurethane. The Zund Operating Manual UVjet 215-C is very helpful in discussing this fact: "…PU coating that improve adhesion and prevent the ink from penetrating into the fibers."

**Substrate**, a material onto which you can print with UV-curable ink which does not have to be coated. If the material is coated, it is called media. The substrates that printer manufacturers tend to mention as compatible are:

- Artboard
- Cardboard, especially for boxes
- Ceramic tiles
- Foamboard
- Foamex
- Gatorfoam
- Glass
- Metal
- Plexiglas
- PVC
- Sintra
- Styrene
- Vinyl
- Wood

Specialty items include leather and stone, among others.

**Undercoat,** is not a standard term; it is usually called an inkjet receptor layer, the minute layer of chemicals which receive the inkjet ink and facilitate a reaction which results in the color and quality that users expect nowadays. However, since UV curable ink does not require an inkjet receptor layer, our discussion of this subject is in the glossary and other reports in the FLAAR series on media.


*Substrate samples manufactured by Alcan Composites. These materials are designed to be printed with an inkjet printer and don't need to be pretreated.*

## FLAAR inspection of a printing company specialized in glass and plastics

Every year FLAAR visits major tradeshows around the world to be updated in the wide-format printer market and the trends in technology, components, software, etc. 2009 hasn't been the exception.

After 4 days of taking notes on APPPEXPO '09 trade show in Shanghai, GCC, the Taiwan-based printer manufacturer, organized a visit to a print business called Eyes Digital UV Print Center, a print business that specializes in applications in non traditional materials; we could see laptop keyboard frames being printed on, wood and many types of applications that are not very common in the signage market.

Eyes works in association with Tong Jou Chemical Industrial, a Chinese branch of a Taiwan company that manufactures the primers and coaters. These products allow inkjet printers to print on a wide variety of substrates. We list the range of products of this company and its uses.

**1. Integrated Tube Varnish Series**
This is a specialized top coating for treated PE, PVC, and similar media. Helps improve ink adhesion. This varnish is characterized by offering a high glossy finish and has a fast curing speed. It gives the printed image abrasion resistance and excellent flexibility.

*Eyes Digital Sales Manager and Nicholas Hellmuth with some laptop tops printed on with the GCC StellarJET K100UV.*

*Glass samples and laptop covers printed on using Sinice primer.*

**2. UV Tube Varnish Series**
This is a UV-curable coating, mixed with a PU-acrylate resin and a special acrylic monomer. It is also used to top coat PE, PVC and similar media. It has a stable coating condition. It is re-coatable and provides a good adhesion. Good mechanical properties and chemical resistance.

**3. PU Series**

a. PU Primer
b. PU Transparent primer
c. PU Diversity stain paint
d. PU top coating
    I. PU Semi-gloss top coating
    II. PU high transparency semi-matt top coating
    III. PU anti-abrasion Matt top coating

These series of products is made of polyester resin and polyisocyanate curing agent. These can be used for interior decoration and many applications in wood.

*At left, Dr. Hellmuth holding a glass sample treated and printed at Eyes Digital. At right, Eyes Digital lab staff working in a closed, dust-free environment.*


*Dibond print samples. In these samples the reflective surface of the substrate interacts with the print area to enhance the result.*

*In these Dibond print samples, the ink covers all of the surface.*

**4. NC Series**

a. NC transparent primer
b. NC Diversity Stain paint
c. NC transparent top coating
I. NC transparent gloss top coating
II. NC Transparent semi-gloss top coating

These are ideal for bamboo and related products: furniture, handcrafts, etc.

Eyes uses a GCC combo-flatbed (with moving transport belt). A comment was made during the day's visit that someone had read a FLAAR Report about the GCC (there is a FLAAR Report specifically about UV-curable printing on ceramic tiles). I would list GCC as the first company that makes mid-range and entry-level UV-cured printers that has a relationship with chemists who fully understand the entire workflow.

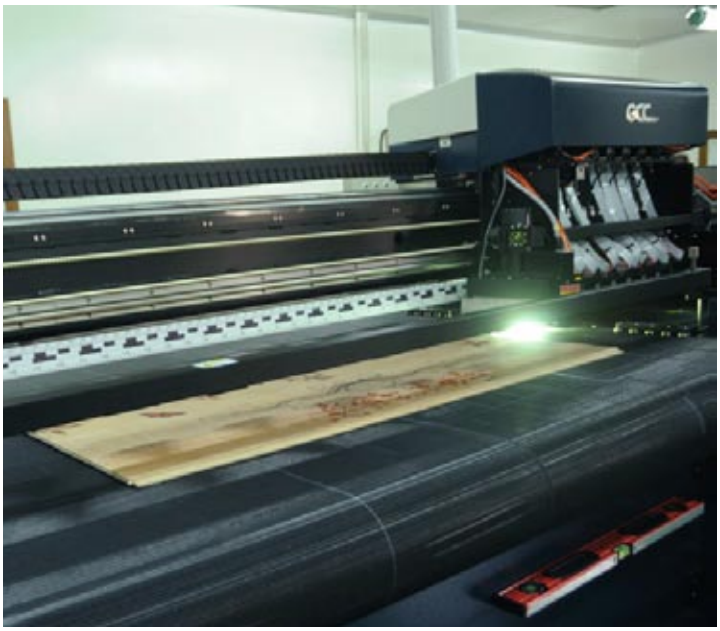
WP Digital is the other company where I have seen specific projects (remember, anyone can have their PR agency add the word glass to their brochures). But WP Digital, and GCC, actually have chemists and a team that is assigned to work on this project.

Other printer manufacturers are now aware of the need to offer a solution to print on glass, Plexiglas (acrylic) and other

*GCC StellarJET K100UV combo printer at Eyes Digital UV Print Center.*

slippery hard rigid materials. But to convince me that there is a chemical workflow, I need to see an alliance with a university or chemical company. Otherwise merely printing on glass is not enough.

At FESPA Digital Europe (Amsterdam, summer 2009), the booth of a Korean company had a really pretty design all around the booth on glass or acrylic. But it was made only for the trade show and would be thrown away afterwards; it had no primer and no top-coat, and would not have survived in a real building under actual use out in the real world (they fully realized this, but for a trade show booth printing on the glass without primer was considered acceptable).




*Wood boards being aligned to be printed on. Tong Jou Chemical also manufactures pretreatment liquids for wood.*

*Nicholas Hellmuth (far left), Eyes Digital Sales Manager and Jason Su, GCC Product Manager evaluating some print samples. Eyes Digital is not only a print business but also a GCC distributor in Shanghai.*

*Sign shop owners interested in a GCC StellarJET UV printer were also invited to visit Eyes Digital facilities after one of the days of Shanghai '09 tradeshow.*

*Jose Melgar, Technical Writer for FLAAR Reports.*

## Concluding comments for unique applications: Printing on leather

Any brochure that claims that their printers can print on leather, or on fired ceramic tile, are potentially actionable. At best they are misleading or at least totally naïve (bluntly, they are clueless). I am amazed that an honorable company can claim such totally unrealistic applications.

Anyone can spray ink on leather: but does it crack? Does it peel off ? Does it cover the leather with a layer of ink so it still looks, and feels, like real leather?

Since FLAAR evaluations and comments on wide-format printers are read by more than 428,000 people (on UV-cured and solvent ink printers) and more than another million people on water-based printers, we try to offer our readers a reality check to soften the misleading PR releases, naïve spec sheets, and unrealistic claims of most UV-curable inkjet printers. Merely exhibiting print samples on ceramic tiles or glass in your booth is, sorry, meaningless unless the company knows the chemistry and physics involved.

Fortunately there are now several UV printer manufacturers who recognize the huge market potential as long as a complete workflow is available. You will see more of this at SGIA 2009, ISA 2010, and FESPA 2010.


*These images are crops of brochures we collected at one of the many trade shows we attend. You can see many companies tend to exaggerate in advertising claims. Affirming the ability to print on everything should be taken carefully.*

# Appendix A

### A few aspects of realistic workflow for UV-printing on architectural materials

## Priming vs. Flame Treatment, Pros and Cons.

### Advantages of Primers: Economic and Easy

Coating your media with a primer is relatively easy. You apply it manually or with machinery, depending on your budget and the type of material.

If you are on a tight budget, you apply it with a brush, with spray, a good paint roller, a foam roller, etc. For more porous (rougher) surfaces you might need to apply the primer with a brush. Rougher surfaces need more than one layer of coating if a smooth surface finish is desired.

Also, when covering the surface manually, you might find bubbles and brush strokes, but they disappear as the primer dries.

If you have an industrial production demand you might require applying the primer with the appropriate machinery like a low-pressure spraying unit or a rod applicator machine.

*This is the drying unit used to fix the primer on tiles that will be printed on with the GCC StellarJET 250UV at **Print in One** sign shop, Taiwan.*

### Disadvantages of Primers: Green Awareness

Primers, in some cases known as adhesion promoters frequently use chlorinated solvents that are highly flammable and toxic. The concerns about these products are not only in terms of health but also in terms of the environmental impact that are considered to have high VOC emissions (Volatile Organic Emissions, organic chemical compounds that evaporate quickly and that contribute to photochemical smog in the atmosphere).

### Advantages of Flame Treatment: Green Awareness and Treatment levels

Flame treatment has the advantage that there is no ozone production and has a lower treatment decay rate. Other advantage is that with the improvements on the design of burners and control systems, flame treatment offers higher achievable treatment levels. It is also considered that the substrates that are treated by flame tend to have a longer shelf life than substrates treated by other procedures.

### Disadvantages of Flame Treatment: Repeatability

A downside of flame treatment is that it repeatability becomes difficult, especially due to the variables involved in this method; fuel and air supplies may vary from one day to another. Changes in ambient temperature alter the air-gas mixture ratios and changes in gas composition change the nature or effect of the flame and it becomes difficult to achieve a consistent result.

Other disadvantages are related to price and security. To do flame treatment you need equipment that tends to be more expensive to install and to operate than other processes. The idea of having a flame and related equipment in a print shop is one of the strongest reasons why this method is not as popular as other ways of treatment.

But in general, you as operator or print business owner, need to realize that the claims in advertisements for UV-curable ink printers may not admit the degree to which some materials may have to be pre-treated with primers, corona treatment, or flame treatment. An owner of a VUTEk 200/600 said that VUTEk actively suggested that he obtain an ionizing air gun (SIMCO G165 for a Cobra ionizing air gun). He hangs this at one end of his printer. However the effects of corona treatment gradually diminish with time, so you need to use corona-treated material before the effect wears off.

First issued August 2009.

These are some of the most

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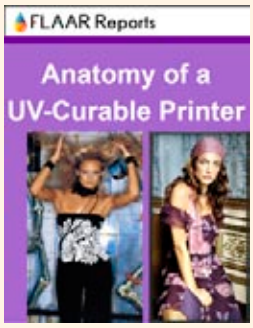
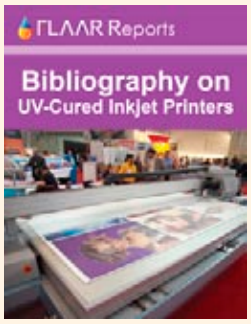
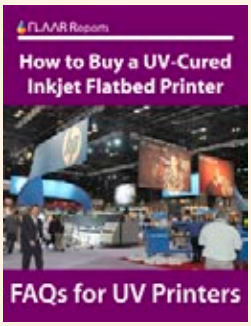
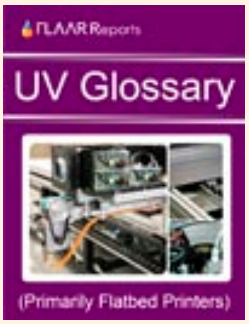
Introduction to UV Curable Inkjet Flatbed Printers

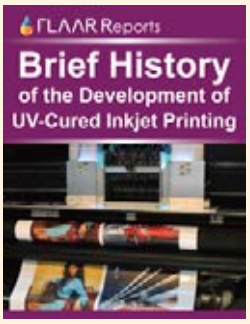


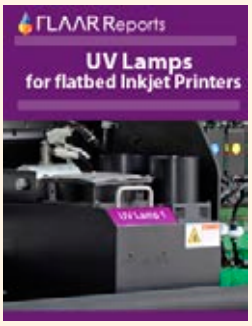


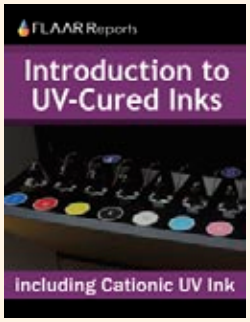






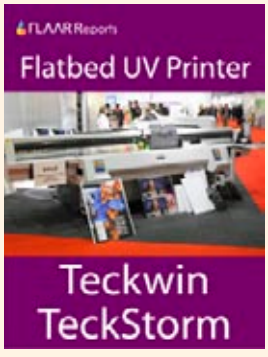





Most recent UV Printers







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