

What about White Inkjet Ink?

The all-new Infiniti M.
Designed to outperform.



Infiniti-me.com

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Introduction

Lots of people want white inkjet ink.

- Artists frequently ask why they can't get white ink.
- Photographers would like to experiment with the effects white could add to the mood of their fine art prints.
- Sign makers and screenprinters need white ink to print on dark materials.
- Print shops need white ink as background for translucent materials for images in color.
- T-shirt makers need white ink to print on dark shirts.

But despite these needs, the market has not previously been large enough to cover the developmental costs to produce white ink for printing on dark materials or on translucent materials.

The other reasons have to do with chemical considerations: making the ink "white enough" is a challenge for chemists. White ink would not always be opaque enough; it would be too transparent.

Even though white inkjet ink does not yet exist other than for UV-curable inks and eco-solvent inks, a search for white inkjet ink on Google turned up four pages of spam from cheap inkjet refill junk sites, all eagerly offering white ink. I suspect that few or any really offer white inkjet ink. But they know users are dying to find white ink, so they spam the search engines to offer what people want. But when you were gullible enough to click on their alluring links all you get is "cheap, bulk, refills" of all colors but white, for Epson, HP, and Lexmark CMYK colors.



Dr. Nicholas Hellmuth, FLAAR and Paul McGovern, Mimaki, at Mimaki demo room with two print samples on a clear substrate onto which white ink was used.

UV-curable white ink sources

UV-curable printers do now offer white ink. At SGIA '03 trade show Azero (Creon) and Mimaki both offered white ink with their UV-curable inkjet printers. This ink is not water-based like inks for a Canon, Epson or HP; UV-ink is flash-cured with UV light.

Codent offers "white, red, blue, and yellow" inks for printing onto black substrates. Their ink summary does not indicate whether this is a UV-curable ink or not (www.codent.co.uk/inks.html).

Hilord makes fluorescent colored ink and seemingly white ink, but I could not get specifics easily from their web site, www.hilord.com

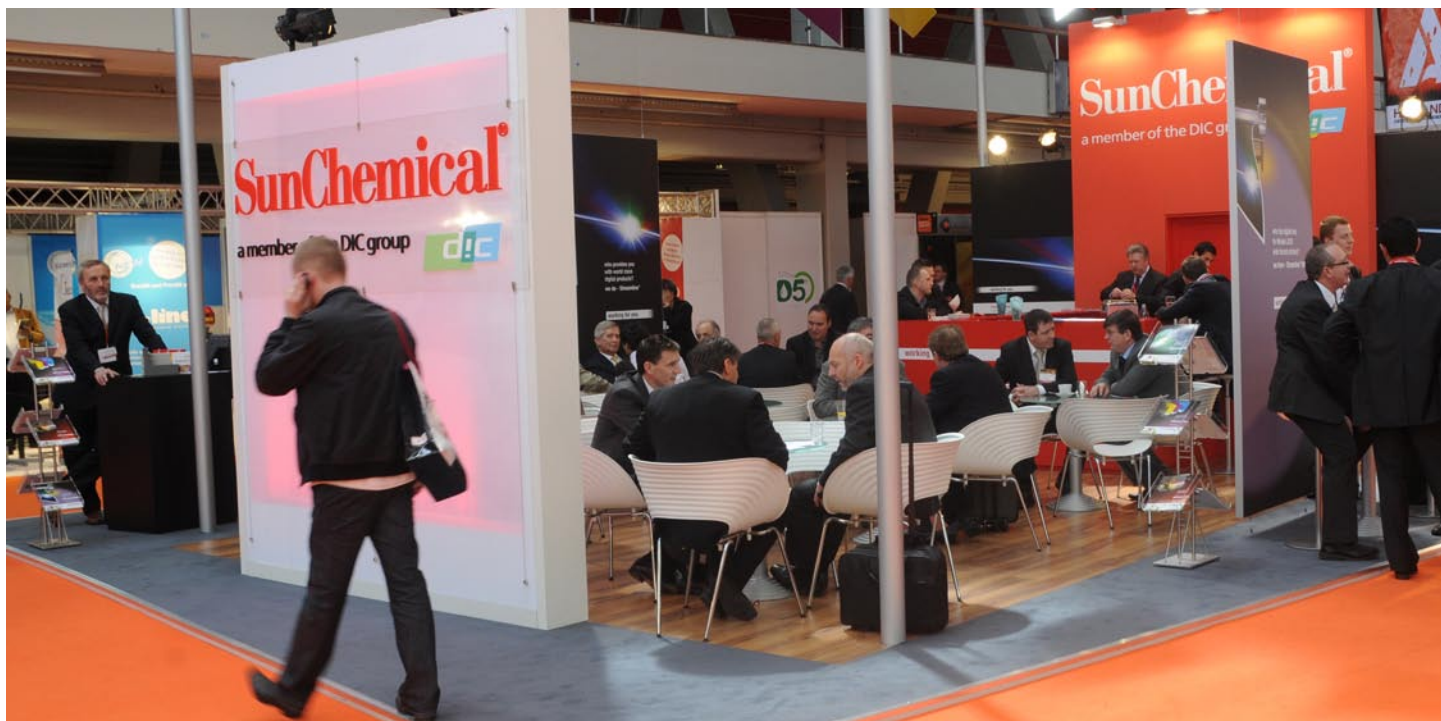
Markem has a white inkjet ink which appears to be for printing diagrams onto green printed circuit boards (www.markem.com/spotlight/spotlight.jsp?spotlight=215). Hard to tell whether this is the same white ink as marketed by Aellora Digital, which is a Markem Company (www.aellora.com). Unfortunately Marken totally dropped out of white UV ink development in 2007 and the Aellora hybrid-ink projects were all dropped by them.

Tetenal AG is a German company that makes some inks for inkjet printers. Their white ink has recently been certified for use with Spectra printheads. However I rarely see or hear of Tetenal products actually in use, at least not in the US.

Xaar's XJ500 printhead has white UV-curable ink for printing labels. www.theprintdirectory.co.uk/tp1/NewsArchives/newsarchivesDetails.asp?ID=347. Avecia speaks about these inks as well, since they are the ink manufacturer. www.avecia.com/inkjet/industrial/events/imi_amsterdam_b.pdf. As many other industrial inkjet inks, this white ink is used, so far, for coding (www.packworld.com/articles/Products/14308.html).

A practical example of white ink is Aellora's printing on pens, www.aellora.com/images/brightwhite_pen.jpg. The text is very clear if you don't look at it too closely. At FESPA 2005 Aellora showed a new white ink for printing on glass bottles. But as mentioned above, Aellora no longer exists since 2007.

White UV ink may be grainier than other colors: because more is laid down to make it opaque, and because the drop size may be larger.



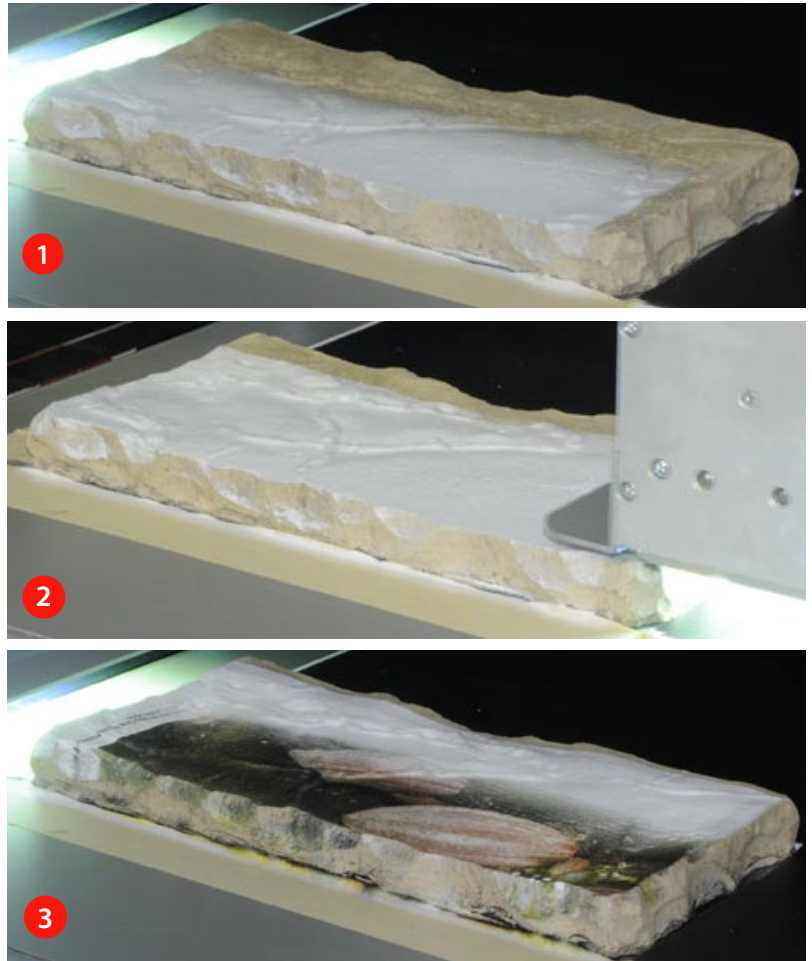
SunChemical began offering white ink in 2009. Here, at FESPA Amsterdam, that same year.

Characteristics of an Ideal White Ink for UV printers

The ideal white ink formulation (leaving aside the fact that white UV ink is also considered carcinogenic) should have these characteristics:

- **Smoothness**
A white ink layer should have an even and smooth appearance.
- **Brightness**
The degree to which light is reflected.
- **Whiteness**
White ink should be in fact pure white, not yellowish white.
- **Opacity**
The color underneath must not be perceptible

Unusual substrates (other than inkjet substrates) are commonly not white. To ensure color accuracy, a first layer of white is needed. But this layer needs to be opaque enough to guarantee the other colors will not be affected by the inherent natural color of the substrate.



Characteristics of a Printer that features White Ink

To understand the technological aspects of a printer that is equipped with white ink, let us understand first the main chemical component on white ink:

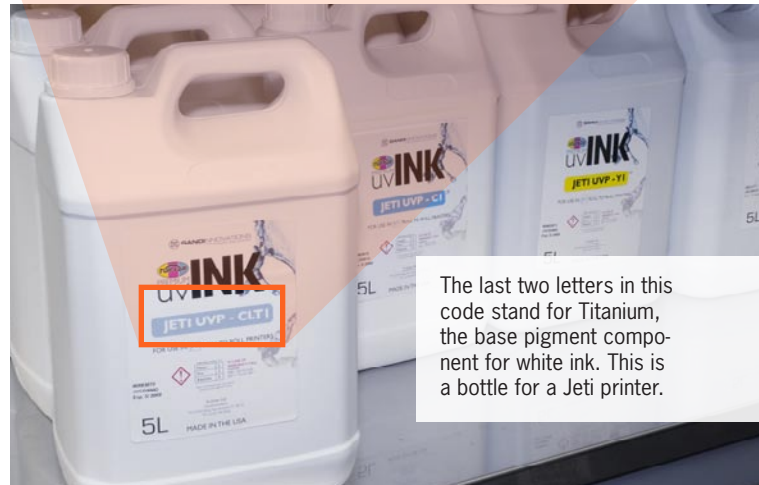
Ink Components:

Titanium dioxide (TiO₂) is the most adequate pigment component for white inkjet ink because of these characteristics:

- Brilliancy
- Adequate color resistance (lightfastness)

But Titanium dioxide also presents these characteristics that make it tough to handle:

- Heavier than other pigments
- Considered carcinogenic (although I have found also articles that say it is "harmless").



The last two letters in this code stand for Titanium, the base pigment component for white ink. This is a bottle for a Jeti printer.

Technological aspects of the printer:

Tubing and Position: Because Titanium dioxide particles are heavier than the pigments in color inks, white ink needs to have a recirculation system to avoid white ink particles to deposit in the bottom of the container. In fact, most UV printers have the white container in a different location than the color inks, because the white container requires this separate system.

Printhead requirements: White ink needs more pigment material to be opaque enough. This means that white ink is thicker than color inks. How does this affect printheads? White ink needs printhead models with a bigger drop size than color inks. For example, the Dilli Neo Titan UV1606W printer uses:

- Konica Minolta 512 (14pl) for CMYK inks, and
- Konica Minolta 512 (42pl) for white ink.

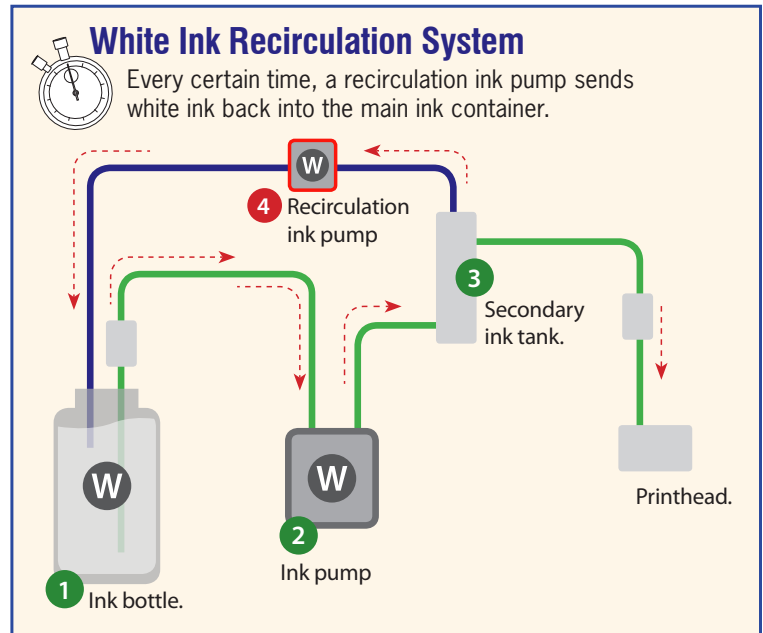


Illustration by Jose Melgar. Copyright FLAAR 2011

Other Practical Aspects of White Ink:

Another aspect that needs to be taken into consideration by printer manufacturers and potential buyers is shelf life of white ink. Generally, shelf life of CMYK inks is 12 months. Although some articles warn about a shorter lifespan for white ink, some recent FLAAR evaluations on different UV printers mention a shelf life equal to the color inks.

Which UV-curable printers offer white ink?

Aellora, Azero Creon, Mimaki and Durst were the first to show their printers cranking out white ink consistently. A more recently updated list would include:

Agfa

- :Anapurna Mw
- :Anapurna M2050
- :Jeti 3020 Titan

CET (Chin E. Technologies)

- X-Press F512/16
- X-Press FK512/12

Dilli

- Neo Titan UV-1604DW
- Neo Titan UV-1606W
- Neo Titan UV-2506W
- Neo Jupiter UVJ-1006



Dilli Neo Titan UV2506W at APPPEXPO Shanghai 2010.

Durst

- Rho 1000
- Rho 800 and Rho 900
- Rho 500R
- Rho 205
- Rho 600



Durst Rho 800 UV printer at FESPA Amsterdam 2009.

DYSS

- Apollo R160
- Apollo R220
- Apollo R250
- Apollo RF260



DYSS Apollo R160 at ISA 2008.

EFI

- Rastek H650 and H652*
- Rastek T660*
- Rastek T1000



EFI VUTEK GS3200 at the company's demo room.

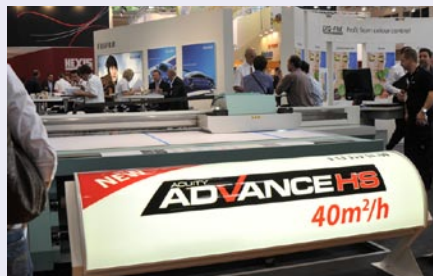
- VUTEk QS 3220*
- VUTEk QS 3200r*
- VUTEk GS 3200

Fina

- Infiniti UV1612S

Fujifilm

- Acuity Advance HS
- Acuity Advance HS X2*
- OnsetS20*



Fujifilm Acuity Advance HS printer at FESPA Munich 2010.

Gandy Digital

- Pred8tor

GCC

- StellarJET K72uv*
- StellarJET 250uv *

Grapo

- Gemini *
- Manta White

HP

- Scitex FB500
- Scitex FB700



HP Scitex FB500 at FESPA Mexico 2010.

InkTec

- Jetrix 3015 FQ *
- Jextix 2513 FRQ

KIP (see GCC)

Lotte

- InnoJet 900UV



Mimaki UJV-160uv at APPPEXPO Shanghai 2010.

Mimaki

- JFX-1631 *
- UJV-160 *
- UJF-706
- UJF-605C II
- UJF-3042



Mimaki UJV-160uv at APPPEXPO Shanghai 2010.

Oce*

- Arizona 350 GT
- Arizona 350 XT
- Arizona 550 GT
- Arizona 550 XT

Polytype

- Virtu RS35/48 *
- Virtu RS35/48/10 *



Polytype Virtu RS35/48 printer at ISA 2010.

Roland

- LEC-300, 330 and 540

Screen

- Truepress Jet2500UV

SkyAir Ship Skyjet

- FlatMaster
- GlassMaster
- FlatMaster+Roll



SkyAir Ship Skyjet FlatMaster+Roll at APPPEXPO Shanghai 2010.

SwissQPrint

- Oryx
- Impala

Teckwin

- TeckSmart
- TeckStorm
- TeckStorm TS-300



Teckwin TeckStorm TS-300 at APPPEXPO 2010.

WP Digital

(see Polytype)

Comments of UV printer manufacturers regarding white ink.

- HP is one of the companies with more UV printers in their portfolio. Yet only two HP models feature white ink.
- It is evident that almost no company offers white for dedicated roll-to-roll UV printers. Roland is the exception.
- VUTEk was one of the last known manufacturers to implement white ink. However, EFI is currently the company that features white ink in almost all of their models, including the VUTEk and Rastek families.
- One of the few big names in the wide-format printer industry that does not feature white ink is Gerber.

White ink is tricky to handle. For this reason I have not yet seen many Chinese UV-cured inkjet printers successfully handle white ink. Note I say successfully. More and more Chinese printers retrofit their machines with white ink, but whether this is successful will need to be tested in the real world.

Historical comment: At Viscom Duesseldorf Gandinnovations showed white ink and varnish for the first time (October 2005). It can take a while for the RIP software to catch up, since white is not merely another hue; white is not merely ultra-light black!

The Zund 250 was withdrawn in 2005 due to problems with trying to use a premature cationic ink chemistry. Virtually all successful UV printers use a free radical ink chemistry. To learn about the difference we recommend an article in a summer issue of Digital Graphics magazine. The Zund 250 was re-introduced at SGIA in late 2006 but was gracefully retired in 2007.

Mimaki's white ink

Mimaki does not identify the printheads used in any of their UV-curable ink machines². But whatever brand head, the quality they produces is rated at 1200 x 1200 dpi. I assume that is multiple passes. I have seen the output and the quality of the Mimaki is superior to any other inkjet printer. The caveat is that the printers are, to large degree, still experimental with respect to many substrates.

Just realize that these Mimaki printers are intended for industrial markets, not photo labs. The Mimaki is currently limited to 23.4 inches on the UJF-605C and related series, and 42" on the roll-fed UJV-110 UV plotter.

Roland's white ink

The first Roland white ink was eco-solvent and was not very opaque. Now (2010) their white ink is better.



Sample printed with a Gandinnovations Jeti UV flatbed printer at Joslin Signs.



Mimaki UJF-706 narrow-format UV printer at ISA 2010.

Durst's white ink

Durst featured their white ink capability at DRUPA 2004 trade show as an upgrade on the Rho 160 to the Rho 160Wplus. Durst printers are at the high end, as you would expect for the manufacturer of the Lambda LED photo printer. So their advertising features an attractive photograph of a white goose along with geese of other colors. Durst uses Spectra heads so achieves a respectable quality. FLAAR has a separate site-visit case study comparing a Durst Rho and a Zünd printer.

Whereas some companies add white ink just so they can make their spec sheet look impressive, companies of the stature of Durst actually have the technical chemists and engineers to understand how to handle white ink.



Durst Rho 351R. The white ink is at a different level than the rest of the inks.

Aellora's white ink

Note: For further considerations, we notify that Aellora went bankrupt several years ago.

The quality of white ink on dark substrates that Aellora tweaks out of Spectra printheads is phenomenal. Most of the samples Aellora produces at trade shows are on black Lexan, a rigid plastic sheet with a glossy surface. The text on these samples is essentially flawless. I do not notice any of the embarrassing edge splatter as found on virtually every other inkjet printer at DRUPA.

As far as I can tell only Aellora uses its own white ink but since their quality is better than anyone else but Mimaki, it would behoove other manufacturers to partner with Aellora.

Because companies that do not offer white ink are claiming it does not work, I thought I would add this photo essay of SGIA 2004 and DRUPA 2004 to show one "Success Story," namely Ael-



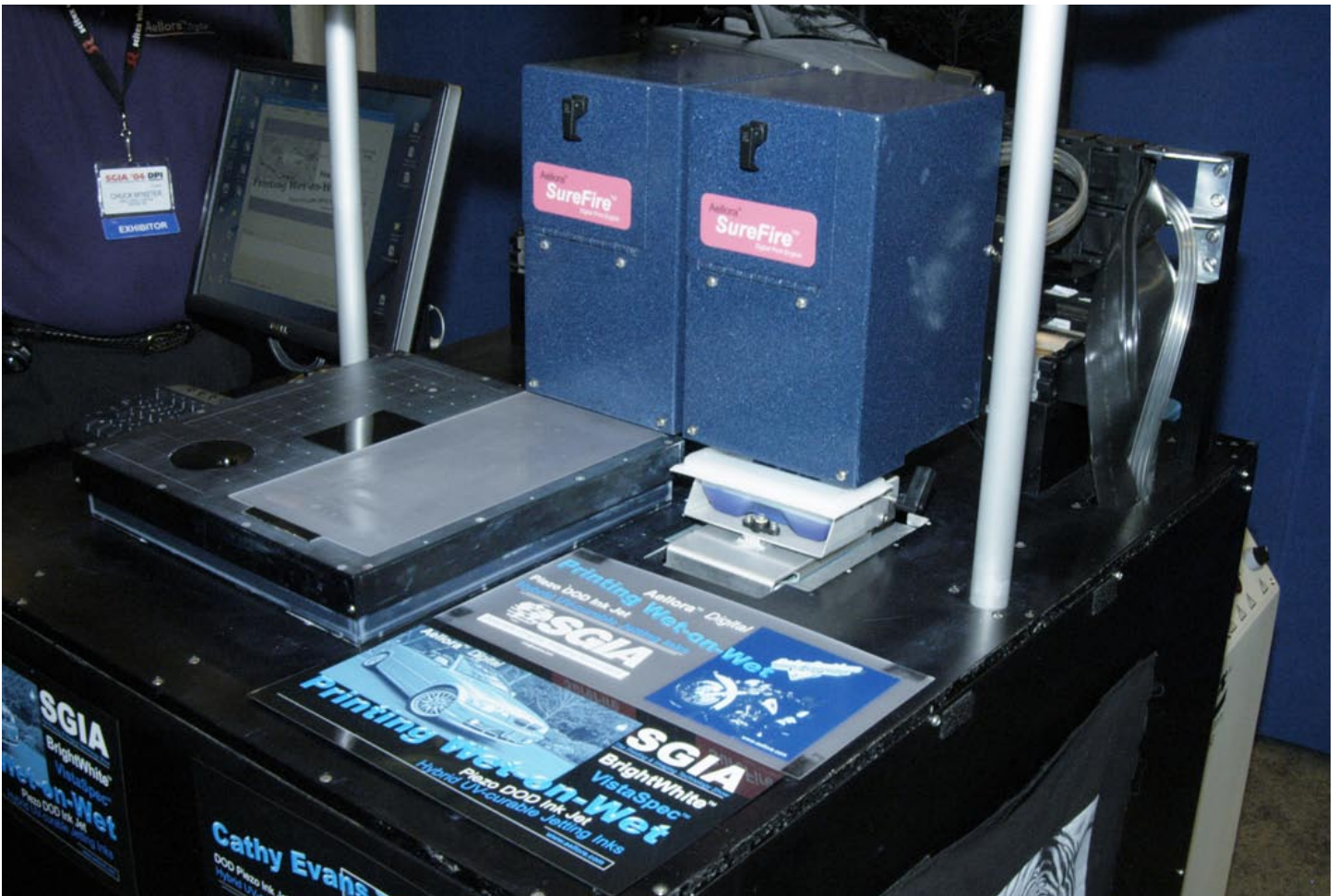
Aellora SureFire at SGIA 2004.

lora's own white ink. True, we would have to find this in an actual site-visit case study to document it. In other words, just because a product works in a manufacturer's booth is no proof that it works in the real world. But site-visits are generally done as sponsored research. In other words, an outside company sponsors either FLAAR and/or the university so that funds are available to get out and judge the product in a real-world situation. But until such funds are available, at least we can show the photo essay of the booth display.

In the meantime Aellora was closed down by their parent company, so this innovative white ink chemistry is no longer available.



Aellora white ink at DRUPA 04



Aellora SureFire white ink at SGIA 2004.

Other company's white ink

At DRUPA (May 2004) lots of companies were talking about white ink, but the only ones who were actually printing white ink every day for the two-weeks of DRUPA were seemingly Aellora, probably Durst, and Mimaki. I did not note to what degree Durst was actually printing as opposed to primarily displaying white production. Mimaki has been printing white ink at all year 2004 trade shows, especially in June at NBM 2004. Mimaki showed white ink samples and a prototype printer at ISA 2003, but it was not printing in public at that early date. Aellora has been printing at all 2004 shows where they exhibited.

Creon listed two white inks for their Azero printer. I will have to check on their production quality at SGIA in October 2004. I will see the Durst again there, and at Photokina in Cologne, Germany. Unfortunately Azero Creon did not exhibit any UV-curable ink flatbed printer at SGIA 2004 or at any US trade show in 2005. So there is no way to report on whether it works, or not. These printers were manufactured by Hypernics, in Korea. Azon sells comparable printers (from Hypernics) into Eastern Europe. But neither Hypernics nor Azon exhibit at any trade show we have ever attended in Germany or the US. By late 2004 or 2005 Hypernics was out of business. Azero Creon went out of business about the same time. The successor company of Hypernics in Korea is IP&I. Their UV printer is indeed being shown in the USA (at ISA 2006). The quality was excellent.

Other companies are not as far advanced in getting their printers with white ink into full production, out of beta stage. DuPont has the most sophisticated system for delivering white ink.

In the beginning Vutek did not offer white ink in any of their UV-curable ink flatbeds. The Vutek people told me that white ink does not work in any way, shape, or form. Strange, because by the time of SGIA 2004 (October), Aellora, Durst, and Mimaki had mature printers producing output with white ink. White ink was in a beta-stage UV-printer from Flora, rebranded for DuPont. The Vutek position that white ink did not, could not, and would not work, was all the more transparent during 2004 because shortly thereafter Vutek finally released their own white ink option. It is a shame that this sort of subterfuge goes on just to keep people from buying a competitor's product that has a feature you can't yet produce.

We have reports on Durst, Gandinnovations (Agfa :JETi), Mimaki, EFI VUTEk and EFI Rastek, SkyJet, Polytype Virtu (previously WP Digital) and several other printers featuring white ink in our FLAAR UV Series, available from www.wide-format-printers.NET.



White ink is temperamental. And you can't simply add another ink line and try to jet white ink. But if you know the chemistry and have a system to keep the pigments in suspension, then white ink.

The only way to document that white ink does not work, would be a series of site-visit case studies. Obviously the same site-visits to actual print shops may reveal that white ink works just fine. So as soon as sponsored research funding is available we will head out to locations that are using white ink.

White Ink in Chinese-manufactured Printers

Chinese manufacturers are clever in picking buzz words to add to their advertising ploys. The Chinese know that Spectra heads are considered better than other brands, so the Chinese make a big issue out of offering Spectra heads. They hope the end-user will consider that if a printer uses Spectra heads that everything else in that same machine is as good as the Spectra heads.

In some Chinese printers the entire printer is made of such low-bid parts that having a good head is not much help because everything else breaks down.

Now Chinese manufacturers are adding white ink in the hopes that end-users will think that these printers are sophisticated (like the Durst Rho). But it is unsure whether the white ink really works adequately; it's hard enough in a Durst or a Vutek: there are good reasons why ColorSpan intelligently never attempted to offer white ink: too many issues in its chemistry.



The Zhongye UV-2500 combo printer offers white. Here at APPPEXPO Shanghai 2009.

This is a polite way to say, beware of printers that offer white ink and show it functioning only in a trade show booth or in their spec sheet. The only way to know if it really works is to find a print shop that has this brand and model, and ask both the owner and operator if the white ink really works.

White Eco-Solvent and Solvent Ink

Roland and Mimaki both introduced white ink at ISA 2005. The Roland white is eco-solvent. Mimaki is either a lite-solvent or full-solvent (it is confusing since the ink formulae change every year or so).

Many skeptics have asked out loud whether a solvent white ink can be opaque enough? The Roland ink we saw at FESPA looked okay (the critique was on the Roland white ink shown at ISA). Only you can judge whether their white is opaque enough for you and your clients.

The general opinion at ISA was that Mimaki's white was a tad more opaque. Obviously these two inks will need to be tested and compared (which is expensive).



Mimaki JV5 solvent printer at ISA 07

Where does the manufacturer (engineer/designer) put the white ink?

If white ink is in a cheap entry-level printer, there may be only one printhead for white ink. So it will be either at the front or back of the row of printheads.

If the white ink is in a mid-range model, it will offer at least two printheads for white ink, so there is enough opacity.

White ink in a more sophisticated printer will offer several printheads up front and several printheads at the back of the row. This way the printer can jet white ink coming or going.

The goal is to be able to jet white ink without slowing down the printing process. The owner of a \$300,000 printer is understandably not willing to wait for a job to be finished.

Zund had a clever system for handling white ink

The Zund UVjet 250-Combi printer had a unique position for parking the white ink containers. I spent two days at the Zund factory in Switzerland during the last period that they still were manufacturing UV-cured printers. The last Zund 215 was still being produced. And they were producing about four model 250 printers a month. The 250 was withdrawn from the market not because it was a bad design, but because Zund did not have enough factory space to handle producing both printers and XY cutters. Also they had marketing issues and had stumbled embarrassingly trying to use cationic ink without understanding that they were just guinea pigs for an ink company that could not make it work on their own.

By about 2007 Zund got rid of cationic ink and was using normal free radical chemistry. Their "Combi" printer was actually a unique hybrid that could also add a full dedicated flatbed table. All the description is in the FLAAR Report, the only independent outside evaluation of this innovative wide-format UV-cured printer. What I wish to illustrate and mention here is the position of the white ink.

Epson's white ink

In 2009 Epson launched a secretive white ink that did not have titanium dioxide. Instead of using that traditional white pigment, Epson's ink source uses an optical illusion: it is really an empty bubble that looks white to the human eye.

Epson refused to show me the ink (knowing I might be skeptical). For good reason, we received an e-mail from someone who tested the ink and he said it did not provide even coverage.

Also this ink is for proofing for flexo, so is probably only intended for certain kinds of media.



In the EFI Rastek H650, even the purging system for white is independent of the CMYK channels.



Nicholas Hellmuth at Zund factory, evaluating the Combi 250 UV printer.

White ink for the marking and coding industry

Jet Equipment Corporation sells white ink for industrial inkjet printers such as Videojet, Domino, and Imaje. This ink does not require UV or thermal curing. It prints onto PCB, wire, cable, ceramics, metals, and plastics such as ABS, CAB, and PVC.

You will be able to use an industrial white ink from Vecia ink company through Xaar XJ500, XJ126 and Leopard printheads. www.printondemand.com/MT/archives/003462.html.

While on the subject of marking and coding, it is worth pointing out that Titanium Oxide is evidently used as a tattoo ink too.

How, and When, to Use White Ink

Introduction to different manners of using white UV ink

EFI VUTEK UV printers list the manners of handling white ink as

- Overprint (also spelled as two words, over print)
- Underprint, or base coat (may also be a flood under coat)
- Spot
- Underspot
- Fill
- Overspot

Durst calls its white ink capabilities

- Single hit white
- Double hit white
- Under spot
- Over spot
- Under print
- Over print
- Special effects white

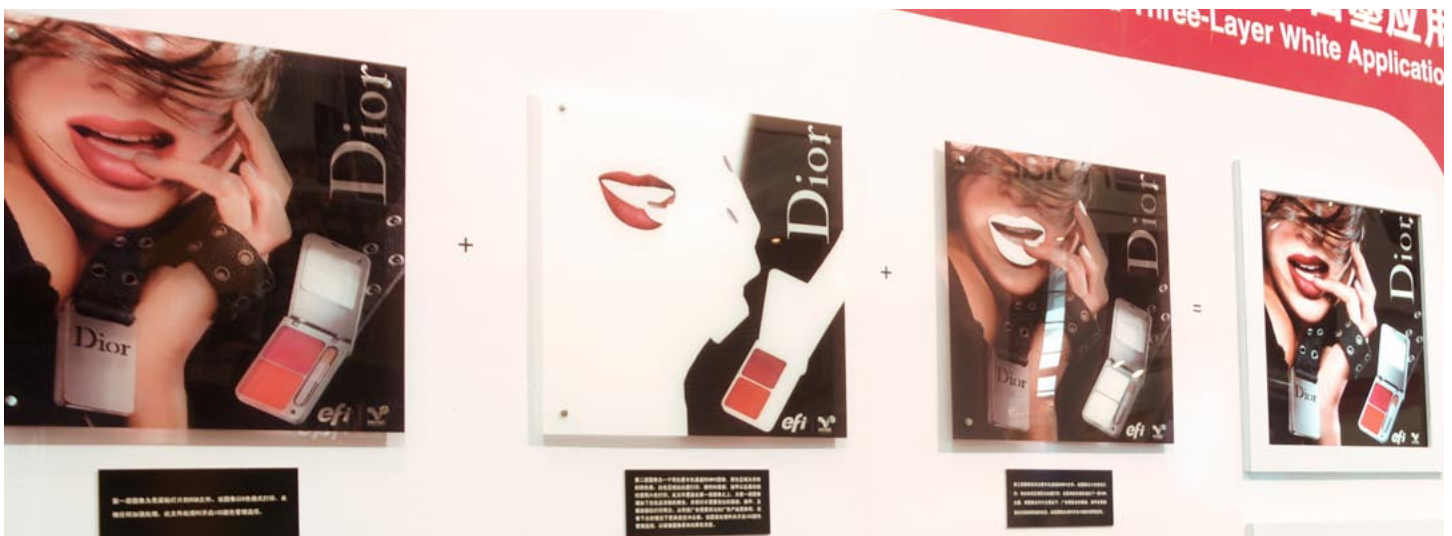
Polytype Virtu RS 25 and RS 35 can accomplish

- Underprint
- Overprint
- Spot color

The Polytype printer has 48 heads each array has three print-heads. White has four arrays, so 12 heads for white. Two arrays are at the left; two arrays for white are at the left. Thus the white heads are the leading heads and final heads in any pass.

VUTEk may use special software from a Spanish company to achieve their white effects.

Full flood is a layer of white under everything.
Underprint can be done as full or selective
Overprint can be done as full or selective.



At APPEXPO Shanghai 2009, EFI exhibited several options of applying white ink, each producing a different application.

White ink for printing onto dark materials

The textile industry needs white ink so they can print onto dark fabrics. Xennia offers such as ink (www.xennia.com/Licensing.htm).

For UV, solvent, and eco-solvent situations, white ink can be a spot color for printing on transparent material. This is where Mimaki UV printers try to be successful.



Magnacrom in Mexico uses white ink on their Durst Rho printer to print fashion advertising. Usually POP signage for this market is printed on dark materials.

White ink for covering materials that need a white undercoat

We went to Home Depot, bought a wooden door, and printed autumn leaves on it. Of course the wood grain pattern showed through. The UV ink (from a Durst Rho 160) was not thick enough to cover over the underlying wood color. So the way to handle this would either be, paint the door white with normal paint, or use white ink to coat the door before printing the colors on top. The white inkjet option would be expensive, but if your print shop does not have the easy capability of painting with regular paint, or if you have a hundred doors to do, then white inkjet is your way out.

This would be called a “flood coat” or an “underprint” or undercoat.

White ink for improving the color contrast

The first time I saw what white ink as a base can do was at a distributor of the Agfa :Anapurna L and XL. An Agfa technician had a file where the white was a base under the color. It made the colors more vivid.

Then I noticed the advertising brochure for the Mimaki JF flatbed printers featured the same concept: use white ink, especially on transparent materials such as acrylic, as a base coat. You then print the colors on top.

Issues

Suspending titanium oxide in a solution and its crystal size are the issues I've read about. With other pigments you can grind them down so they don't clog the nozzles. With titanium oxide, particles below 200 nanometers are translucent (Larson 2003) (what you want is an opaque white, not a translucent white). Companies such as Durst, and their international ink partners, had to redesign their popular Rho printer to accept white ink: "The white ink has its own inking system. This is because the titanium oxide pigments have different properties to other UV-hardening inks and would clog up both the conventional heads and the lines. The solution is a device that pumps the white ink through the ink feeds and stirs the pigments, thus preventing blockages."



Mimaki UJF-605C UV printer. Sample of transparent material

This suggests that if the printer offers white ink, you better make sure it has a dedicated delivery system for the white ink. Cheap off-shore printers will probably attempt to run the ink through traditional ink feeding system. Lets say a European or American UV-curable printer is \$250,000 to \$450,000. You see a cheaper knock off from China, Korea or Taiwan. They advertise one or even two white inks.

How do you know whether the white ink really works half a year after you have finished paying for the printer. If you "save" \$100,000 off the price (and get the cheaper printer for that much less than a really good American or European printer), your savings evaporates when your printer is down, waiting for spare parts that take forever to arrive from a distant continent.

The white ink has to be opaque enough to cover over the dark surface.

In the early days of UV cured ink, some UV light sources could not cure deep enough into opaque white ink layers (www.dotprint.com/fgen/prod1297.htm).

Software and Hardware to handle White Ink

Merely adding another ink line, and putting in white ink, is not enough. The hardware has to have a method to keep the pigment in suspension without clogging the printheads or settling out.

The software (and hardware) needs to accommodate how the white ink will be applied: as a spot color, before the rest of the colors, or printed at the end.



VUTEk software used to create the white layering

Do You, or your Clients, really need White Ink?

Inkjet printer manufacturers and distributors that do not yet have white ink go to great efforts to point out why white ink is a fad, and not meaningful.

By 2007 white ink was available as an option on most high-end printers except Inca. Paul Yandell points how why he feels white ink is not yet really needed on an inkjet printer (2005, IMI conference). But, now even Inca is adding features such as extra colors.

But if your clients want white ink; if you would like to distinguish your capabilities from those of competitors who don't yet have white ink, then white ink is something to consider. And, like many things in life, if it is available, go for it.

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Sources and Resources on the Internet

www.aellora.com/documents/imi_wij_nov03.pdf

Aellora has interesting white ink chemistry.

http://en.wikipedia.org/wiki/Titanium_dioxide

Brief chemistry of Titanium Oxide/ Dioxide

www.jetec.com/ink_white.html

This company sells white ink for industrial inkjet printers such as Videojet, Domino, and Imaje.

www.packworld.com/articles/Products/14308.html

White UV ink for Xaar printheads; ink from Avecia.

www.reade.com/Products/Oxides/titanium_oxide.html

Brief chemistry of Titanium Oxide/ Dioxide

www.sartomer.com/wpapers/4500.pdf

"Preparing a UV White Ink Using a Metallic Monomer as a Reactive Pigment. One page.

www.screenprinters.net/articles/index.php?art=197

"The Mystery of White Ink," by Terry Combs, but for screenprinting, not UV-curable for inkjets.

There was an article on white ink in a trade magazine during Spring of 2004. It may have been in Digital Graphics, March 2004, but I do not have a copy.

http://www.signindustry.com/flatbed_UV/articles/2010-01-15-White_Ink_UV-Curable_Inkjet_Flatbeds.php3

"Is White Ink Capability Really Such a Big Deal?" By Jeff Edwards. Originally published in the SGIA Journal, 1st Quarter 2009.

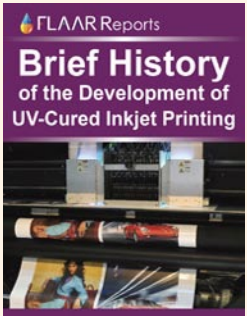
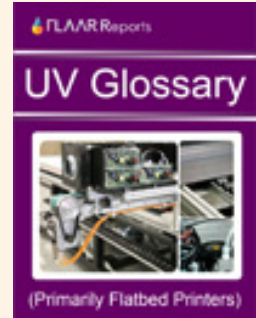
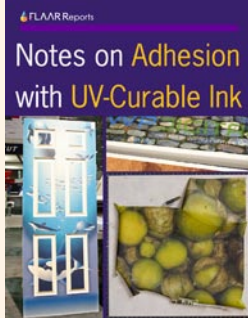
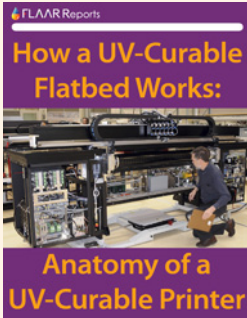
Most recently updated February 2011.

Previously updated May 2008, December 2004. Updated June 2005, after FESPA 2005. Updated October 2005, June 2006, April 2007.

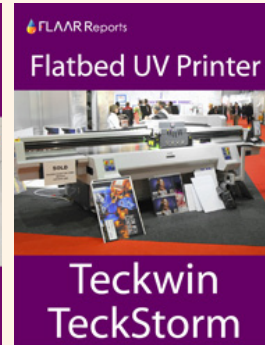
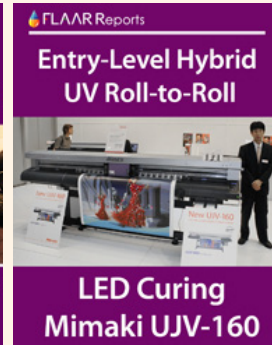
This is a sample of the FLAAR Reports on UV for 2010-2011

There are also even more available from 2009 (some of which are still pertinent).

Introduction to UV Curable Inkjet Flatbed Printers



Most recent UV Printers



Here are examples of the TRENDS level of FLAAR Reports for 2010-2011

There are also even more available from 2009 (some of which are still pertinent).



UV Printers Manufactured in China, Korea and Taiwan

