



BioVu Inks

Changing the
Color of Superwide
Format Printing



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Introduction

The oil crisis of 1973 generated a flurry of interest in the environment, conservation and alternative forms of fuel. But in the years since, the world has gradually slid back into heavy consumption mode, with somewhat less emphasis on introducing petroleum alternatives to the market—until the early part of this decade saw rapidly escalating energy costs across the board with no relief in sight. As a result, general consumer awareness has risen again—consumers are buying alternative fuel and hybrid cars, BIO-fuel commercials are rampant, and BIO-based has become one of the hottest buzzwords in the market.

Meanwhile, environmental regulations in many countries of the world continue to tighten and corporations are undertaking “Green” initiatives, further incentive for finding more environmentally sound ways of doing business. In the printing industry at large, companies are moving to chemistry-free printing plates, using soy-based inks, offering recycled papers, recycling waste and taking other steps to reduce their environmental footprint.

In the superwide format segment of the industry, however, especially in the production of materials for outdoor use, the need to use solvent-based inks to produce vibrant, durable pieces has been a barrier to producing truly environmentally friendly printed materials for these purposes. Additionally, emissions from conventional solvent-based inks need to be limited to avoid potential health and safety issues for workers in the facilities in which they are used. Now, with the commercial availability of BioVu inks from Inkware, a subsidiary of EFI, the world leader in digital imaging and print management solutions, the health, safety and environmental picture for this high-growth segment of the industry has changed dramatically.

This white paper defines the various types of inks in use in superwide format printing, including their respective environmental impacts, and explains why BioVu inks from Inkware comprise a totally new class of ink that stands to make a significant difference in the environmental footprint of superwide format print applications. It also includes customer feedback on the business impact of these new inks. For providers of superwide format printing, it is easy to be “Green” with BioVu inks from Inkware.

What determines if a product is environmentally friendly?

A product is considered environmentally friendly if it uses the 12 Principles of Green Chemistry:

1. *Prevent waste: Design chemical syntheses to prevent waste, leaving no waste to treat or clean up.*
2. *Design safer chemicals and products: Design chemical products to be fully effective, yet have little or no toxicity.*
3. *Design less hazardous chemical syntheses: Design syntheses to use and generate substances with little or no toxicity to humans and the environment.*
4. *Use renewable feed stocks: Use raw materials and feed stocks that are renewable rather than depleting. Renewable feed stocks are often made from agricultural products or are the wastes of other processes; depleting feed stocks are made from fossil fuels (petroleum, natural gas, or coal) or are mined.*
5. *Use catalysts, not stoichiometric reagents: Minimize waste by using catalytic reactions. Catalysts are used in small amounts and can carry out a single reaction many times. They are preferable to stoichiometric reagents, which are used in excess and work only once.*
6. *Avoid chemical derivatives: Avoid using blocking or protecting groups or any temporary modifications if possible. Derivatives use additional reagents and generate waste.*
7. *Maximize atom economy: Design syntheses so that the final product contains the maximum proportion of the starting materials. There should be few, if any, wasted atoms.*
8. *Use safer solvents and reaction conditions: Avoid using solvents, separation agents, or other auxiliary chemicals. If these chemicals are necessary, use innocuous chemicals.*
9. *Increase energy efficiency: Run chemical reactions at ambient temperature and pressure whenever possible.*
10. *Design chemicals and products to degrade after use: Design chemical products to break down to innocuous substances after use so that they do not accumulate in the environment.*
11. *Analyze in real time to prevent pollution: Include in-process real-time monitoring and control during syntheses to minimize or eliminate the formation of byproducts.*
12. *Minimize the potential for accidents: Design chemicals and their forms (solid, liquid, or gas) to minimize the potential for chemical accidents including explosions, fires, and releases to the environment.*

Source:

Paul Anastas and John Warner, Green Chemistry: Theory and Practice, Oxford University Press: Oxford UK, 1998



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Market Demand

The market for environmentally-friendly inks is growing globally as governments worldwide continue to address the health and environmental concerns associated with conventional solvent-based inks and call for the reduction of the release of volatile organic compounds (VOC's) containing Hazardous Air Pollutants (HAP's) into the environment. At the same time, customers are making it clear; they want the ability to print superwide graphics directly onto uncoated substrates without the need to use expensive ventilation systems. They are looking for the same durability and substrate selections they use with solvent printing, and they are looking for these products to cost the same as solvent printing materials. However, compared to traditional solvent inks, most inks marketed as environmentally friendly (i.e., eco-solvent inks or aqueous inks) fall short in versatility and performance.

Categories of Inks for Super-wide Format Printing

By definition, a solvent is a liquid substance – any liquid, even water – capable of dissolving another substance. In the digital inkjet world, however, the term “solvent” is used to describe any ink that is not water-based.

Other industry-related terms used to describe solvent inks include soft, mild or eco as well as hard, strong or true. The most confusing of these terms may be eco-solvent ink. To most, “eco” is short for ecological. Most of the eco-solvent inks available on the market today, however, are neither derived from a renewable resource nor created through an ecologically sound process.

Before discussing the various categories of inks available on the market, it is important to understand a few key terms and acronyms that are commonly used in conjunction with ink manufacturing and use:

- HAP: Hazardous Air Pollutants
- VOC: Volatile Organic Compounds
- TAP: Toxic Air Pollutants
- Cyclohexanone: a common solvent used in full solvent ink
- NMP: n-methyl pyrrolidone, a very aggressive solvent that has a poor toxicological profile
- PEL: Personal Exposure Limit as set by OSHA, a limit to protect the health of Printer Operators.

Now let's take a closer look at the common terms applied to the various types of inks in use for superwide format printing and the health, safety and environmental issues associated with each:

- UV Curable Inks: These inks have no VOC's, but they do exhibit low PEL's and poor health and environmental profiles. This means that there are safety issues with relatively low exposure levels.
- Water-based Inks: These inks are extremely limited in application since they tend to be less durable, less weather-resistant, and generally need to be applied to a coated stock.
- EcoSolvent™ Inks: These inks are the same as light solvent inks. They are less aggressive, but they exhibit poor health and environmental profiles. They contain HAP's and VOC's.
- Mild/Light Solvent Inks: These inks are the same as traditional solvent inks, but with slightly less aggressive solvents. However, the solvents still have poor health and environmental profiles, contain HAP's and VOC's, and have low PEL's.
- Full Solvent, traditional inks: These inks use aggressive solvents with poor health and environmental profiles. They contain HAP's, TAP's, VOC's, and have low PEL's.

In an entirely new approach to solvent-based inks, EFI, through its ink company Inkware, LLC has developed the first solvent-based ink made from a renewable resource (namely, corn) for use in the VUTEk product line as well as for use with superwide format printers manufactured by others. It is the only solvent-based ink recognized by the U.S. Environmental Protection Agency (EPA) and creates an entirely new class of inks, BIO Solvent inks:

- BIO Solvent Inks: Contain no harmful VOC's and have the best health and environmental profiles available. These inks have high PEL's, meaning employees must reach high exposure levels before they must be concerned about any health or safety issues.

Despite its earthy origins, BioVu™ ink delivers all of the benefits of traditional solvent inks without the compromises inherent in eco-solvent and aqueous inks. This includes the same color gamut as traditional solvent inks so that users can seamlessly switch to these environmentally conscious inks with no workflow or prepress process modifications.

Ink Properties for Outdoor Displays

A majority of superwide images printed for outdoor display are printed on low-cost, nonabsorbent, uncoated materials, such as self-adhesive vinyl and banner material. The importance of resulting prints that are weatherproof, UV-resistant and scratch-resistant cannot be overstated. In order to meet these performance criteria, solvent inks use a pigment in powder form and, as the media is nonabsorbent, a resin or glue to adhere the pigment onto the substrate surface.

The solvent is used only as an agent to make the ink into a fluid for jetting. Non water-based liquids are often used as the solvent, since it is easier to produce a waterproof image using resins that are not water-soluble. Once the ink has been applied, the solvent evaporates (releasing VOCs), leaving only the pigments on the material. Most printers use on-board heaters to speed the drying process.

True solvent inks dry faster, need fewer heaters built into the printing system, and soften the substrate surface for better bonding with the pigments. Graphics printed with solvent inks bond better to a wide range of uncoated substrates, are more durable, offer better UV resistance, and withstand a greater degree of mechanical wear. What's more, uncoated vinyls cost dramatically less than vinyls used with traditional water-based inkjet printers and up to half as much as specially treated substrates required with first-generation eco-solvent inks.

Like other true solvents, BioVu inks are durable, provide strong bonding to uncoated substrates, and resist mechanical wear and UV light. BioVu inks are designed specifically to run in high-production environments, provide high print quality, and to print on a wide variety of pressure-sensitive and textile materials and rigid media. Ongoing testing on additional substrates will expand the available range over time.

Other benefits inherent in the new BioVu inks include:

- Lower expected disposal costs since there are no hazardous materials (hazmat)
- Reduced odor on final printed materials
- Less objectionable than solvent for both employees and the environment.

In new shops or installations, ventilation and burner systems may no longer be required since there are no government occupational, safety or health requirements for special treatment of the harmless VOC's emitted by BioVu during the drying process.



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The Difference is in the Ink

Eco-solvent and aqueous inks often use slow-drying solvents and therefore need more heaters to aid the drying process, increasing the likelihood of some substrate puckering under all that heat. For this reason, eco-solvent and aqueous ink usually have to be printed on coated materials (coated materials are often more expensive than non-coated) so the printer can put more ink on the substrate. The ink receptive coating modifies the surface tension so the ink will apply to the media without causing print artifacts.

Running Costs

Most true solvent printers are equipped with bulk ink delivery systems to reduce running costs. The running costs for BioVu inks are within the same range as conventional solvent inks, while yielding the additional benefits for the printer, employees and the environment of the removal of hazardous materials. In fact, running costs will be lower overall due to a number of factors, including:

- Elimination of the need to install costly, specialized ventilation systems and burners to dispose of harmful VOC's.
- Reduced cost of substrates with the elimination of the need to use specialty or coated substrates.
- Increased employee satisfaction as a result of a healthier work environment.
- Reduced energy costs due to faster drying times and less consumption of energy by heaters used in the drying process.
- Reduced cost of compliance with governmental occupational, safety, health and environmental regulations due to a proven environmentally friendly production environment using BioVu inks.
- Recaptured production space formerly consumed with ventilation and other systems that can be put to revenue-generating use.

Composition

Superwide format printers have traditionally used solvent inks that contain EB Acetate that is classified as a hazardous air pollutant (HAP). BioVu's primary ingredient contains a biologically derived solvent with a far more positive health and environmental profile than commonly used solvent ink chemicals. BioVu is free from ethylene glycol ethers, cyclohexanone, NMP, aromatic hydrocarbons, vinyl esters, or other hazardous ingredients.

BioVu ink uses over 60% Ethyl Lactate, which is approved by the FDA as a flavor additive for use in food. Ethyl Lactate is an alternative solvent that is non-toxic and biodegradable. Since BioVu ink is over 80% bio-based, it may be the best ink on the market for the environment. Keep in mind that with all of the publicity and buzz around bio-friendly fuels, bio-based diesel contains only 5% of volume derived from corn, with the other 95% being diesel.

The other components of the ink include the binder, derived from cotton and wood pulp; and Jet Wash, a blend of Ethyl Lactate and another solvent derived from Soybeans.

With a flash point of greater than 141° F, BioVu ink has very low volatility and potential for flammability; it can be safely shipped by all modes of transport.

EPA Recognition

BioVu is the first and only solvent ink to be recognized by the U.S. Environmental Protection Agency's (EPA) Design for the Environment (DfE) program. This partnership is part of a DfE safer chemical use initiative for commercial formulators. The basic goal of the initiative is to seek, assist, and promote innovative chemical products, technologies, and practices that benefit human health and the environment.

A key purpose of the Inkware-EPA/DfE partnership is to recognize and encourage environmentally preferable chemistry based on the "12 Principles of Green Chemistry" (see sidebar). BioVu inks, developed under a Memorandum of Understanding (MOU) with the EPA's DfE initiative, are a set of patent-pending printing inks – based on the special properties of its bio-solvent formulations.

BioVu inks are a biologically-based product and contain a solvent derived from corn. Bio-based products such as BioVu inks reduce dependency on oil reserves, benefit local farmers, are safer for the environment and protect workers' health. Additionally, the corn-based solvents used in BioVu inks are not hazardous air pollutants, pose no threat to the ozone layer, and are biodegradable surfactants with byproducts.

In addition to EPA recognition, VUTEk BioVu ink from EFI was recently tested by an EFI vinyl substrate partner in a biodegradation test with their biodegradable media. The preliminary results of that test showed that both the media and ink biodegraded in landfill.

Carrying the EPA DfE Logo

Authorization to carry the EPA DfE logo means that the DfE review team has screened each ingredient in the product for potential human health and environmental effects and that - based on currently available information, predictive models, and expert judgment - the product contains only those ingredients that pose the least concern among chemicals in their class.

For example, if a DfE-recognized product contains a surfactant, then that surfactant must biodegrade readily to non-polluting byproducts; many surfactants in conventional products biodegrade slowly or biodegrade to more toxic and persistent byproducts, which threaten aquatic life.

BioVu Inks: The Time is Right

As the world's resources become increasingly constrained in the Twenty-First Century, private citizens, governmental and non-governmental agencies, educational institutions and corporations are becoming more focused on reducing their environmental footprints. As a result, "BIO-based" is a current buzzword, drawing a lot of attention from the media to the boardroom. Oil-based products—and the means to migrate away from them—are receiving extensive attention because of escalating costs and unstable supply. And consumers are willing to spend an additional 30% or more to purchase automotive hybrids and alternative fuel cars.

As they continue to produce highly visible outdoor advertising, superwide format printing businesses will come under increasing pressure from many of these constituencies to, in turn, reduce their environmental footprint. Sometimes this will take the form of customers weighing in with their wallets; in other cases, regulatory compliance or community pressure will be the drivers.

In January of 2005, the U.S. government passed into law the Farm Security and Rural Investment Act of 2002, which makes it mandatory for any government agency to buy BIO based products when available. An example would be materials used in military recruiting advertising. In addition, the U.S. and many other countries are enacting, or considering the enactment of, tighter occupational, safety, health and environmental regulations that will make it more difficult for superwide format printing businesses using solvent inks to both stay in compliance and stay in business.

BioVu inks represent a technology whose time is right. Market demand and awareness are building for bio-based solutions with continued pressure to migrate away from petroleum-based products where possible. Businesses producing superwide format products, especially for outdoor use, can differentiate themselves to gain competitive advantage, while at the same time reducing costs of operation, by using BioVu inks.



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Using BioVu Inks

As with any new technology, BioVu inks must find market receptivity and make a real difference in real businesses. And the inks have done just that during the stringent field tests they underwent prior to commercialization.

The Big Print, a leading provider of superwide format printing services with production operations in Seattle and San Francisco, is one customer that has adopted EFI's environmentally friendly VUTEK BioVu inks as a key element of its trademarked BioGraphix product line.

The Big Print, founded in 1999 in a garage in Marin County, California, includes among its client base national retailers, large agencies and other businesses requiring indoor and outdoor display graphics and signage, including bus and building wraps, banners, billboards and more. "Many of our customers have made the decision to lessen their environmental footprint," said Jon Zinsmeyer, The Big Print's founder and President. "To meet that need, we have sourced a variety of environmentally friendly materials, including fabrics manufactured in VOC-free factories and pressure sensitive vinyl alternatives. Until now, the missing link was environmentally friendly inks for superwide format printers. VUTEK BioVu inks from EFI have filled that gap."

Zinsmeyer adds, "We can now offer a total environmental solution to our customer base. Combining BioVu inks with our new VUTEK 3360 solvent printer and our range of environmentally friendly substrates is as good as it gets at this time. We look forward to EFI expanding availability of these inks to the rest of its solvent-based VUTEK superwide format printing products."

BioVu inks are available in eight colors (cyan, magenta, yellow, black, light cyan, light magenta, light yellow and light black), and are specifically formulated for superwide format inkjet printing operations.

The Substrates

BioVu inks can be used on a wide range of flexible substrates. Results achieved on pressure sensitive vinyls have been outstanding. Excellent results have also been achieved on a wide variety of rigid media with no pretreatment. BioVu inks deliver good results on coated papers, photo substrates, blue-back, and poster materials. Products produced with BioVu inks are 2-year outdoor durable, and 5-year with topcoat. Their abrasion and chemical resistance is good.

What's Next for BioVu?

Inkware BioVu inks have been optimized to operate with the VUTEK UltraVu® II 3360 product line from EFI to achieve excellent color density and adhesion to a wider range of substrates, increasing the number of flexible applications. EFI plans to extend BioVu applicability to other printers within its currently-available VUTEK solvent product family as well as to those of selected OEM partners.

Mutoh America has featured Inkware's OEM version of this technology with its MutohBIO™ inks running on a low-speed flatbed, printing directly on rigid substrates, Inkware plans to selectively work with other OEM partners to expand the range of superwide format printers that can take advantage of the significant benefits this Bio-Solvent ink offers.

As part of the MOU with the U.S. EPA, Inkware will make continuous environmental improvement an important element of its research and development activities.

Summary

Each year, commercial formulators use millions of pounds of chemical ingredients that one way or another find their way into the environment. Until now, there hasn't been an environmentally-friendly ink available that delivers all of the performance benefits of a traditional solvent ink. The advent of BioVu ink has done just that by creating a whole new category of inks aimed at addressing concerns for human health and the environment, while satisfying practical business needs. BioVu ink is made from renewable resources, so it's good for the environment; and it's solvent-based, so it's good for business. Today, customers have the choice of selecting a true, environmentally-friendly solvent ink that not only best matches their overall business need, but also satisfies their environmental conscious.

The introduction of BioVu inks is aligned with parent company EFI's long-held commitment to improving the environment and benefiting the company's global customers. Unlike many new products which are step change improvements, BioVu is a revolutionary advancement representing EFI's commitment to protecting an increasingly fragile Earth.

In addition to the development of environmentally friendly VUTEK BioVU inks, EFI has been leading by example with other environmentally conscious initiatives. EFI Fiery® digital print servers were among the first to ship as RoHS-compliant (Restriction of the use of Hazardous Substances), representing an unprecedented engineering development effort and manufacturing implementation. Additionally, EFI's 10-story, 300,000 square foot corporate headquarters is designed to harness the Earth's natural resources to aid in heating and cooling the space. EFI's energy conservation measures save the equivalent of 783 kilowatts of energy per day, which is enough to power approximately 600 homes.

About Inkware

Inkware was founded in Las Vegas in 1994. The company was purchased in 2000 by VUTEK, the leading manufacturer of superwide format printing devices. VUTEK was ISO 9002 certified in 2004. In June of 2005, VUTEK was acquired by EFI, the world leader in digital imaging and print management solutions (see below). Inkware supplies inks to EFI for its VUTEK product line and to selected OEM printer manufacturers. It has a full product line of solvent, UV, dye-sublimation and bio-based inks. Inkware has a strategic alliance with Spectra for ink development.

About EFI

EFI (www.efi.com) is the world leader in color digital print servers, superwide format printers and inks, and commercial and enterprise print management solutions. EFI's award-winning solutions, integrated from creation to print, deliver increased performance, cost savings and productivity. The company's robust product portfolio includes Fiery® digital color print servers; superwide digital inkjet printers, UV and solvent inks; industrial inkjet printing systems, print production workflow and management information software; and corporate printing solutions. EFI maintains 23 offices worldwide.



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303 Velocity Way
Foster City, CA 94404
[650] 357 3500
www.efi.com

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