

# Soft-Solvent Based Inkjet Inks for Uncoated Vinyl Printings

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## Abstract

For outdoor signage and wide format printing, solvent based inkjet inks have become more and more important due to the outdoor weather durability requirements. There is a trend to solvent system from aqueous system on this particular application.

Almost all of solvent based inkjet inks require a special solvent ink delivery system to prevent the severe solvents from damaging the printer, limiting solvent inks to work only on the solvent printers, which will extremely limit the application range of printers.

After an extensive and exhaustive research and development, Graphic Digital invented a new concept of soft solvent based inkjet inks that work well with all types of printers, no matter solvent or aqueous printers, no matter thermal or piezoelectric head technologies, no matter wide formats or even deskjets, without changing printer ink supply system to be directly printed on uncoated vinyl for outdoor signage and poster printing applications with long term of weather durability. This unique high quality inkjet ink with much lower VOC is environmental friendly.

The theoretical concepts, technical features, and testing results of soft solvent inkjet inks will be detail discussed in this paper.

## Introduction

For outdoor signage and wide format printings, solvent based inkjet inks play a more and more important role due to the outdoor weather durability requirements. There is a trend from aqueous system to solvent system on this particular application.<sup>1</sup>

Almost all of solvent based inkjet inks require a special solvent ink delivery system to prevent the severe solvent from damaging the printer. That limited the solvent inks to only work on the solvent-type printers, which has extremely limited the application range of printers. Many printer manufactures are devoted to explore various solvent-type printers, like Vutek, Scitex, Arizona, Mimaki JV-3, Roland SolJet, Mutoh Tucan, etc.

However, the current reality is that most of the existing printers have water-based systems. So, if customers want to print with water based inkjet inks on vinyl, they have to use coated vinyl which is much more expensive than uncoated

vinyl and increases printing cost. If they want to print on uncoated vinyl, there are only two choices: buy a new solvent printer with solvent based inkjet inks to perform the job, or buy Encad VinylJet 36<sup>2</sup> which has modified with heating uncoated vinyl before printing to receive the water based inkjet inks. All above options are kind of hard decisions for the printers, because they have to invest somehow before undertaking new printing business.

Is there an easy way to overcome this barrier? The answer is yes! After an extensive and exhaustive research and development, Graphic Digital invented a new concept of soft solvent based inkjet inks work well with all types of printers, no matter solvent or aqueous printers, no matter thermal or piezoelectric head technologies, no matter wide formats or even deskjets, without changing printer ink supply system to be directly printed on uncoated vinyl for outdoor signage and poster printing applications with long term of weather durability. Also, this unique high quality inkjet ink with much lower VOC is environmental friendly.

The theoretical concepts, technical features, and testing results of soft solvent inkjet inks will be detail discussed in this paper.

## Background

As the main banner and signage printing substrate, uncoated vinyl is non-porous or non-absorbing polyvinyl film. Unlike coated vinyl, there is no ink receiving layer on the surface of uncoated vinyl. Usually, its surface energy is much lower than that of water based inkjet ink. The contact angle of ink on the uncoated vinyl surface is larger than 90°. <sup>3</sup> The uncoated vinyl surface won't be wetted very well by water based inkjet ink. That is the reason why water based inkjet ink is not able to stay on uncoated vinyl to perform a good printing job. Encad VinylJet 36<sup>2</sup> is a wide-format printer, specially designed for overcoming this problem. The printer will heat uncoated vinyl up first just before printing, when the uncoated vinyl is heated, its micro-holes on vinyl film will open to receive the printed inkjet inks. After printed, while vinyl substrate passed the heating area, it will be cooled down to lower temperature, the micro-holes on vinyl film will contract to encapsulate the received inks. That is a very talent idea! Especially for water based inkjet ink users and environment. However, its lack is the customer has to buy this new printer to perform the job.

Besides modifying the printing machine, we also can modify on the ink side to fit this task of printing on uncoated vinyl with water based inkjet printers, as long as we fully understand the mechanism of the interaction between inks and substrates. Solvent based inks, for example, screen printing inks, perform very well with uncoated vinyl substrates. The only problem is water based inkjet printers won't be durable for such severe solvents, e.g., ketones and acetates, which are commonly used in solvent inks. So, what we need is to find out the replacement solvents with much less severe problems with these water based inkjet printers. The most important thing is that the solvents we have chosen in this case should be compatible or working well with uncoated vinyl substrates, but should be mild with the ink delivery system, including ink tanks, cartridges, tubes, and print heads etc. equipped on the water based inkjet printers. This is the principle.

### Soft Solvent Based Inkjet Inks – EnviroVinyl

For water based inkjet printers, some parts are made from polymers, e.g., polystylenes, polyvinyl chlorides, or polyethylenes, and polypropylenes, etc. Especially in thermal print head type of printers, ink tanks are made of polystyrene type of polymeric materials. They will be dissolved or etched by ketones, acetates, and such severe solvents. When these types of solvent fill in the water based inkjet printers, the printers will “melt” or be destroyed. Therefore, these types of solvents should be avoided or minimized when using in water based inkjet printers. Due to the weather durability requirements for outdoor display printing, we can not choose water soluble dyes as colorants. We have to choose water insoluble dyestuffs or pigments. On the other hand, we also need to consider the ink adhesion on uncoated vinyl, otherwise, inks won't stick on the non-porous and non-absorbed vinyl surfaces.

Based on comprehensively understanding this whole system, Graphic Digital has invented a hybrid solvent based ink system to be used on outdoor printing with water based inkjet printers, it is named EnviroVinyl. This solvent based inkjet ink is a very mild or very soft solvent system. It is a solvent system, but it is soft. It will not hurt regular printers. This unique new family of inkjet ink is able to perform the same or similar tasks as solvent based inkjet printers printed on uncoated vinyl but with water based inkjet printers without changing any ink delivery system on the printers.

EnviroVinyl, which is soft solvent based inkjet ink, can be applied on almost all types of printers, no matter solvent or aqueous based inkjet printers, no matter thermal or piezoelectric print head technologies, no matter wide formats or even deskjets printers. We have tested it on many types of printers, all were with big success. Of course, this is a series of inkjet ink family with different versions, specially designed for different print head technologies, thermal and piezoelectric drop on demand (DOD) systems.

It possesses a lot of obvious advantages as follows:

1. Saving printer costs or investments for most printers.  
For signage or banner printing shops it is not necessary

to buy a new solvent printer to perform outdoor display printing jobs on uncoated vinyl substrates. Most of water based DOD inkjet printers are survived even on the trend towards more and more solvent based inkjet inks for outdoor printings.

2. Saving the cost of printing, which is the media saving. The printers do not have to use the expensive coated vinyl substrates to perform the same job with water based inkjet inks. They may use Graphic Digital's EnviroVinyl inkjet inks to print on uncoated vinyl substrates. It will cut down the media cost lots, which is the biggest portion of printing cost, e.g., dollar cost of per square foot.
3. EnviroVinyl inkjet inks possess another property and that is a much lower VOC than other regular solvent based inkjet ink. It is more environmental friendly than others. This character will lead EnviroVinyl to be more successful than cost saving issue.
4. EnviroVinyl inkjet inks provide full color gamut, settling-free, clogging-free, long time shelf life, water proof, good lightfastness, weather durability for outdoor signage and banner display printings.
5. EnviroVinyl inkjet inks can be used in all types of drop-on-demand (DOD) inkjet printers, piezo heads or thermal heads, solvent printers or aqueous printers, wide-format printers or desk jet printers.
6. EnviroVinyl inkjet inks also can be printed on the most wide range of media substrates, uncoated vinyl or coated vinyl, non-porous substrates or porous substrates, non-absorbed media or absorbed media, high-glossy photo films or semi-glossy photo papers, it minimizes the media selection.
7. EnviroVinyl inkjet inks provide various versions for the different print head technologies, piezoelectric or thermal, dyes or pigments, long lasting photo printings or outdoor durable printings.

Of course, like anything in the nature, EnviroVinyl also has some points need to be improved: It is not working very well with a few uncoated vinyl substrates, which are very slick surface and very low surface energy. Its adhesion to this type of uncoated vinyl needs to be improved. Its drying speed needs to be raised up.

### References

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3. Atkins, P. W.; P. 209, Physical Chemistry, 2<sup>nd</sup> Edition, 1982.

### Biography

**Dr. Jie Wang** is the general manager and director of research & technical of Graphic Digital, Graphic Sciences, Inc. He is a world recognized, experienced scientist in polymer science, physical chemistry, analytical chemistry, and organic chemistry, especially in inkjet ink chemistry and technology with contributions to lots of publications and patents for sciences and technologies. He graduated

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