PDS International Limited

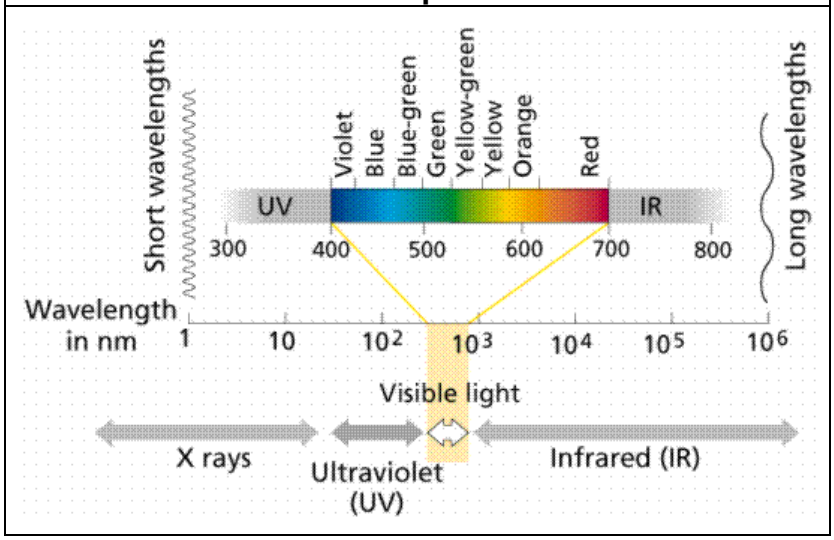
# INKTELLIGENCE

Well we're still here. We survived swine flu, the millennium bug, the melting ice, WMD's and expenses scandals. There is one continuum in all of our lives and that is Ink. We deal with it every day and take it for granted. Ink is a highly sophisticated fluid that in some cases has remained unvarying over the years but in others is constantly developing. Two major changes that have influenced the development of ink in recent times have been the abolition of heavy metal pigments, lead, cadmium, chromium etc and the need to diminish the use of solvents. Both of these changes are brought about by the imperative to reduce Health and Safety and Environmental hazards.

I used the word unvarying in the previous paragraph, of course this is not strictly true as inks may have maintained the same name over the years but the formulations would have changed to suit the regulations. More subtly an ink producer will buy materials from the same source but the origin of component parts will change, for example pigments may come from Chile or China and their wettability could be different which in turn means the ink formulator will have to make small changes in the mix to take account of this. One thing you can be certain of is that ink makers take their responsibilities very seriously and will do everything possible to provide consistent formulations. In the UK we are fortunate to have a rich vein of specialist ink manufactures, Small Products Limited and Apollo Colours Limited are typical examples of specialist producers. Of course the mega multi-national players such as Sun Chemicals and Fujifilm Sericol still sit astride the screen printing market but these larger companies are seeing increased opportunities in the graphics Digital Printing field.

Most people use one or two different types of ink without knowing what is available to them. Screen printing is an ink friendly process and there is the widest selection of ink chemistries available to the screen printer.

**Visible Spectrum**




The greatest division is between radiation cured inks and solvent based inks. Ultra violet curing is one of the radiation curing systems, there are also microwave curable and electron beam curing. UV curing is by far the most common with the others being used in very specialist applications. The main difference between UV (Ultra Violet) curing ink and Solvent based systems is that UV inks normally do not contain solvents that evaporate off when the ink is dried and cured. They are very fast drying and because of the lack of solvents will stay open in the screen mesh for a considerable time.

They will only dry and cure when exposed to Ultra Violet light. Normally this is high intensity UV light produced by specialised curing units. UV light is part of the electromagnetic spectrum it is just outside the visible spectrum at the violet end.

Of the other ink types Water Based Ink and Reactive Curing (Two component) ink are the most likely to be used. Reactive Curing are generally the most resistant ink systems available. Often solvent based, although there are UV systems that have similarities. They consist of the ink base and a catalyst. These two are mixed together at a specific ratio stated on the Technical Data Sheet. Drying is a combination of solvent evaporation and the polymerisation between the base and the catalyst. Left to dry and cure at room temperatures they can take several days to cure. Addition of heat reduces the time and improves the product resistance. The cured ink film has high chemical resistance to solvents, acids and alkalis. It can also withstand high temperatures. It is particularly suited to metals, glass and ceramics, where its superior adhesion is most effective. As with any ink the substrate must be very clean for it to stick well.

A useful tip with two component ink systems is to ensure that the temperature of the curing ink film is not allowed to drop below 5$^{o}$C as this can stop the chemical reaction of curing and it may not be restarted. Once fully cured a drop in temperature will not be damaging. Some ink systems must not drop below 15$^{o}$C

Along with these systems are Baking Inks, Oxidation Drying, Sublimation, Textile Inks, Adhesives and specialist mediums adapted for printing.

The main determining factor for choosing ink is how can you dry and or cure it. This may seem obvious but there is no use choosing an Ultra Violet curing ink if you do not have a UV dryer. Equally trying to print a solvent based ink at high speed when all you have is a drying rack is not practical.

Assuming you have the correct means of drying/curing then the next decision is will the ink stick to the substrate you wish to print and once printed will it withstand the effects of the environment in which it is used. Additionally is it suitable for use in your printing machine. To solve this problem ink suppliers produce many different ink types. The ink suppliers often supply charts that show which of their ink systems are suitable for a particular application. Technical Data Sheets will give information about the suitability of a particular ink. You would be amazed how many printers never read the Technical Data Sheets, thinking the only information available is the Material Safety Data Sheet. This is particularly the case in larger companies where the technical information is kept in a managers' office and are never seen by those who really need them, the printers on the shop floor. The ink supplier is happy to provide guidance but most of that will be on the Technical data Sheet. If you have a substrate that is new to you it is worth sending a sample for ink trials.

In every case there is a note of caution given by the ink supplier: "It is the responsibility of the printer to check that the ink is suitable for use on the particular substrate."

This statement is made because the surface of a substrate can vary and the ink supplier can have no control over this.

## SOLVENT BASED INKS

Called solvent based because they contain solvents. There are many positive points but also negative points. It is the negative ones that cause problems in production.

Solvent based inks are very versatile ink systems. The ability to suspend a whole range of pigments and materials in numerous resins that are dissolved in a combination of solvents gives tremendous scope for the ink chemist. Health and Safety issues restrict the use of some materials but there are still plenty to choose from. From the printers perspective maintaining stability of the mixed ink on the screen is challenging but the effects and characteristics that can be achieved are many. Ranging from inks that provide a simple colour to mirror gloss, inks that react to light and heat, inks with electrical properties, photoluminescent inks, inks for every printable substrate. Some people decry solvent based inks but if you have an application that requires a colour that is light fast contained in an ink that sticks really well to a substrate and withstands abrasion and chemical attack it is likely to be a solvent based ink that will provide the solution.

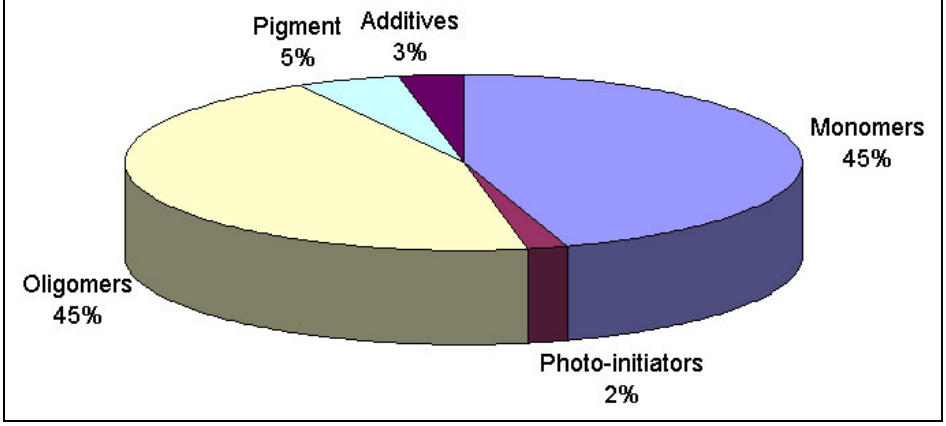
Once inks are mixed the solvents will start to evaporate unless they are kept in a closed container. When the ink is put onto the screen it is changing, as solvents evaporate the ink thickens, flow through the mesh alters resulting in colour variation. It is possible to slow the speed of evaporation by using retarder but this results in longer drying time and can cause the ink to lose its structure. To overcome this you can use a gel retarder that will maintain the structure. When using drying racks more racks and more space are needed. When using a conveyor dryer it has to be run more slowly or hotter or higher airflow. Take care not to run the dryer at too high a temperature as the substrate may shrink or distort. A longer dryer may be necessary. The effectiveness of the dryer is very important. Every printer's nightmare is to have a stack of printed substrate stuck together because the ink hasn't dried. A sensible printer will decide on how to dry the ink before deciding on which printing machine to use. Drying determines the speed of print. This is particularly the case in industrial printing applications where drying and curing will affect the performance characteristics of the finished ink film.

## ADDITIVES FOR CONVENTIONAL UV CURING INK

Whenever you use additives do so with great care. Incorrect use can destroy the properties of the ink.

Adhesion Promoters improve the adhesion of the ink. They may also affect the usable life of the ink. Thinners Gloss/ Matte can adjust colour and the cure time of the ink can be reduced but they may also reduce adhesion. Cured UV ink is normally a hard film which, if bent will crack. Flexibility additives provide additional elasticity but may also reduce adhesion.

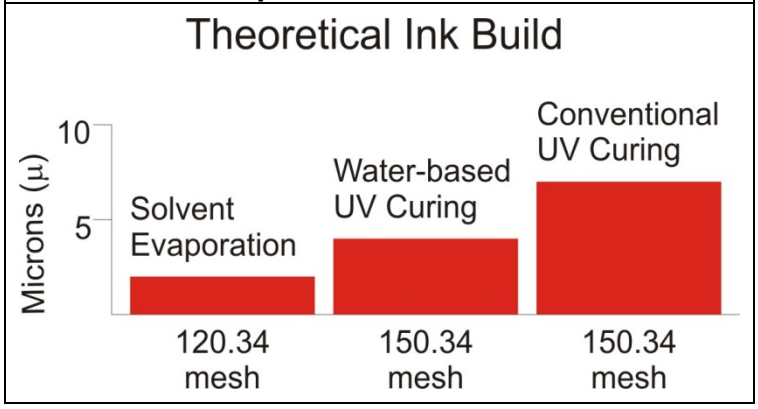
**Basic Constituents of UV Curing Inks**




Water based UV ink was produced by ink manufactures to overcome the ink build problem that occurs with conventional UV. This build is an issue when printing fine four colour halftones as skipping occurs, much of the third and fourth colours do not get printed onto the substrate.

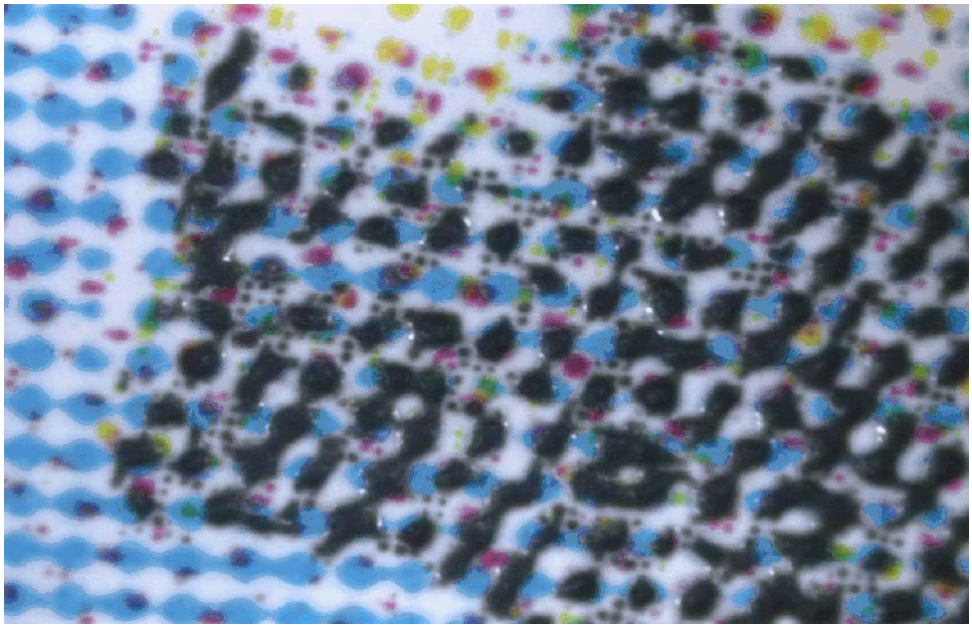
Water Based UV ink contains 45% water. When the ink is printed the water starts to evaporate. This can be accelerated by applying Infra-Red energy (heat) or hot air. The heat produced by the UV curing unit also helps drive off the water leaving a dried and cured thin film. The build is still slightly more than solvent based systems but low enough to reduce the skipping problem.

**Comparison of Ink Builds**

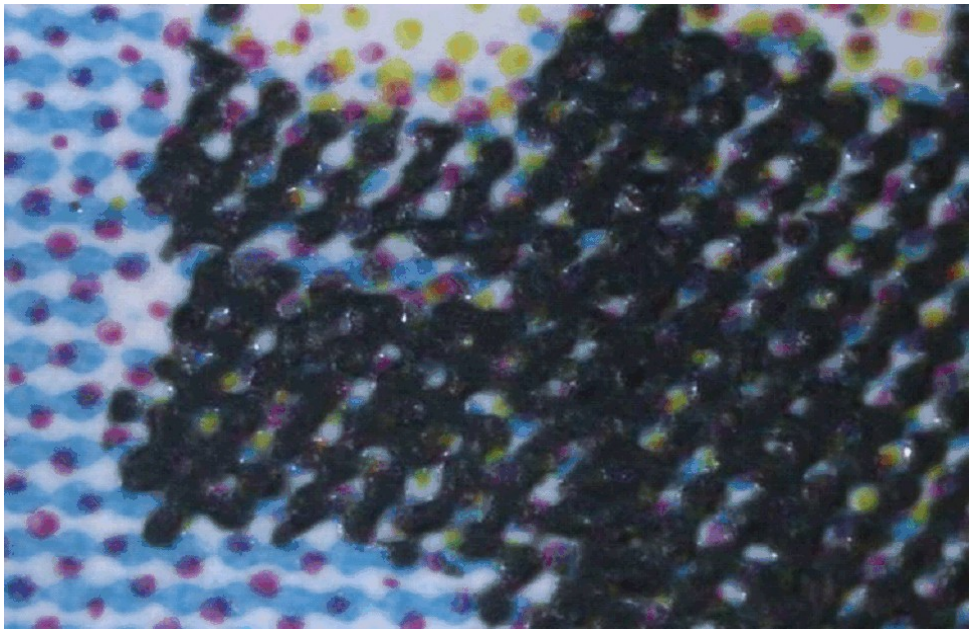



Another solution is to use a very low build stencil that gives an EOM (Emulsion Over Mesh) of 3 microns. Experiments have shown that used correctly very fine line rulings can be printed with conventional UV curing inks without the skipping problem.

**Skipping With Conventional Stencil**



**Top Quality with MacDermid Autotype Capillex CP**



With screen printing all elements of the process are linked together and the competent printer understands the how they interact and can make it a satisfying profitable technology.