

Ultra-Violet curing inks and the Environment

Ultra-Violet (UV) curing inks have many significant benefits in use over traditional solvent-based inks, some of the more tangible benefits being in terms of production. However, one of the major benefits of UV curing inks over solvent-based inks is that they have a significantly lower environmental impact than solvent based inks.

UV curing inks are often talked about as being “environmentally friendly”. This is, however, not strictly true, as they are chemicals, and any chemical in the wrong situation can have a deleterious effect upon the environment. However, it is certainly true to say that the use of UV curing inks has a lower impact upon the environment when compared with the use of solvent based inks. It is the purpose of this document to explore these impacts.

The main environmental impact that the digital-printing process has is in terms of the use of solvents, and it is here that UV curing inks can offer the greatest benefits. The biggest difference between using UV curing inks and solvent based inks for screen printing, in terms of solvent emission, are as follows:

Ink Formulations

Normal solvent-based digital ink formulations tend to contain about 95% volatile solvent. These solvents are evaporated through the process of printing and drying the ink, escaping to the environment. Sericol’s UV curing inks typically contain no volatile solvent.

Cleaning

Because solvent-based inks dry through the evaporation of solvent, they will dry out all the time that they are exposed to the atmosphere. Because UV-curing inks only dry when exposed to UV light, they do not dry when exposed to the atmosphere, reducing the need for cleaning print heads with solvents regularly. UV curing inks tend to be easier to clean so the solvents used can be less harmful, non-volatile products.

Ink production

One aspect that is commonly forgotten is that solvent is also used during the production of the inks themselves. Solvent will be lost through evaporation during production of solvent-based inks and also used to clean the machinery after use. Not containing volatile solvents and being easier to clean introduces less solvent to the environment during the production of UV curing inks.

The impact of solvents on the environment

One of the common misnomers with solvents in respect to the environment is that they contribute to the destruction of the ozone layer and the greenhouse effect. These statements should be treated with care, as the most significant ozone depleters are halogenated hydrocarbons such as CFC’s (chlorofluorocarbons, commonly used as aerosol propellants or refrigerants). These tend to be too volatile (evaporate too quickly) to be useful in most printing process (however they may be used for certain specific applications). Greenhouse gases tend to be low molecular weight carbon compounds such as carbon dioxide (CO₂), carbon monoxide (CO) and methane (CH₄).

This is not to say that solvent emissions from screen-printing are not an issue; they are. Most concern revolves around the emission of VOCs (Volatile Organic Chemicals). These are organic chemicals that have a high vapour pressure and easily evaporate to form vapours at normal temperatures and pressures. This definition covers a wide variety of chemicals, which includes many of the solvents used in the digital-printing process.

Solvents and VOCs often have an unpleasant odour and can cause discomfort at high concentrations. This creates not only an unpleasant workplace but can also cause discomfort and nuisance in the local area around the print works. Many solvents may also have health issues associated with them and may have associated statutory exposure limits; these can place restrictions on their usage in the workplace requiring the use of expensive protective equipment and extraction.

Their environmental impact is normally associated with photochemical reactions in the atmosphere. This reactive atmosphere promotes the reaction of nitrous and sulphurous oxides from vehicle exhaust fumes creating a “photochemical smog”, which can cause, among other things, respiratory problems in some people.

Many VOCs are persistent pollutants and are not easily broken down, remaining in the local environment for long periods of time, for example in topsoil. Some VOCs, when introduced to the water system, can also have significant effects on the marine environment and can interfere with the effective treatment of sewerage.

In many parts of the world legislation exists to limit the amount of VOCs emitted to the environment. In the European Union, the Solvent Emissions Directive places a strict limit on the amount of VOCs that may be discharged (though not on digital processes) and if this limit is exceeded requires the installation of expensive pollution control equipment. It was the introduction of the Los Angeles Pollution Act, 1996, that was a major spur towards the development of UV curing inks as a method of reducing solvent emissions.

One other aspect of solvents commonly used that should not be ignored is the fact that many of them are flammable. This, combined with their inherent volatility can create safety hazards such as explosive atmospheres in work areas and drains. One particular fire hazard is solvent soaked rags, which are commonly found in print areas. These often then require expensive extraction equipment to reduce risks.

Use of natural resources

Most digital-printing inks are derived from non-renewable natural resources such as oil and minerals. Although UV inks are derived from these resources, they are more efficient in their use of them. The greatest difference between UV and solvent-based inks may be seen with coverage. Because UV inks do not dry and have no volatile components to evaporate away, all of the ink ends up on the finished print rather than only a small percentage of it. This means that many more prints can be achieved from an equivalent volume of ink.

What are the environmental advantages of this? Smaller volumes of ink are needed so less packaging is required and less transport is involved in delivering the product. Overall much less natural resource is used per print produced.

Energy consumption

Unless a solvent-based print is air-dried, for production speed it can require some form of hot air dryer. UV curing units tend to use less power than hot air dryers. Studies performed at a major screen printer in the UK have indicated that UV driers use approximately 20% less energy than a hot air dryer*. The ventilation and extraction in the workplace with UV curing inks does not need to be as powerful as it does with solvent-based inks.

*Energy consumption figure from the study (GC88) “UV Inks Save Screen Printer Time and Money”, published by Envirowise in the United Kingdom.

Reduced energy use for curing and production means the energy producer uses fewer resources, such as coal, gas or oil, for power generation, and also therefore leads to less pollutant emission.

Safety

Product safety goes hand in hand with environmental safety. As UV inks require relatively transparent pigments to be used, it is very uncommon for lead chromate-based pigments to be used. These pigments are not only toxic to the environment but also have significant human health risks associated with them. The great majority of UV inks are also formulated to be entirely free of heavy metals (such as cadmium or mercury)

Waste

Substrate usage is also not the only source of waste from the printing process. The use of UV inks can greatly help reduce substrate wastage, but also the ease of cleaning UV inks will lead to a reduction in the use and disposal of cleaning rags and solvents as well as their containers. The greater mileage of UV inks will also lead to a reduction in waste packaging for the inks themselves. The colour stability of UV inks will also reduce the amount of waste ink produced.

Although the use of UV curing inks offers significant environmental benefits over solvent-based inks, this does not mean that the inks themselves do not impact the environment. Most of the benefits seen with UV ink are indirect (such as reduced solvent emissions, lower waste levels, lower power consumption etc). UV curing inks, like any ink or chemical, should be disposed of in line with local legislation, usually categorised as hazardous waste.

An additional attraction in the use of UV curing inks is that the subsequent reduction in material usage, increased mileage and reduction in need for expensive pollution control equipment can lead to significant cost savings for the printer. The production benefits associated with UV inks can also lead to increased profitability.

Many print specifiers, especially major international companies, are becoming more and more environmentally conscious. As they seek to reduce their own environmental impact they will tend to choose suppliers that can contribute to this. As may be seen from the information in this document, the adoption of UV curing inks can assist with this.

Further information and advice on environmental and health and safety issues, including implementation of many of the ideas introduced herein can be obtained by contacting your local Sericol Company or distributor. Assistance can be offered through the local Sericol Technical Services department or from our dedicated team of environmental experts.