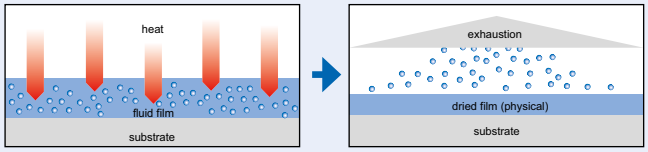
UV-curing ink systems for label printing

At CCL, the origins of radiation hardening with ultraviolet light date back to the seventies. Rolf Wölfle, the founder of the company recognized the advantages of this drying method for label production early-on. One of the key benefits of using UV technology in production is that the printing ink has no chance to dry in the ink well, but hardens on the imprinted material in fractions of a second if UV light is applied. Other undisputed superior features are the excellent gloss and abrasion resistance it achieves in comparison to conventional printing ink. UV technology also offers health protecting benefits, given that UV printing ink usually does not contain any volatile solvents.

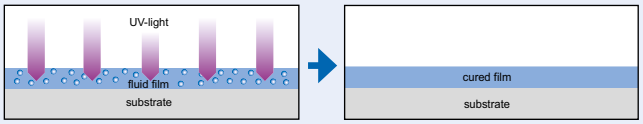
The process of using ultraviolet light for drying is defined as the hardening of a liquid substance (UV printing ink) under UV radiation. In printer jargon, the process is generally referred to as UV curing. To be able to better understand the UV curing process, it is critical to know the difference between the curing of conventional ink and UV cured substances:

Conventional – physical curing



In the conventional curing process, the printing ink is composed largely of pigments, resins and solvents. The solvent may be an oil that dries after a reaction to the oxygen in the air, which is the case with alkyd resin. It may also be a slightly volatile hydrocarbon such as petroleum. If water evaporates from latex paint the process is ultimately a physical curing process.

Chemical curing through UV radiation



In the chemical curing process, UV inks are converted to a solid state through a photo-chemistry process also called interlacing. This polymerization is triggered through the effects UV have on the UV printing ink.

To be able to fully understand the way this works and the properties of UV printing ink, one must take a closer look at the structure and reactive mechanisms of these UV curing materials. Simply put, UV printing ink consists of the components binding vehicles, pigments, photo initiators and additives. Two different methods of UV printing ink curing exist. The binding vehicle and the initiator used in the ink determine the interlacing method: radical or cationic

1. Radical reactive mechanism:

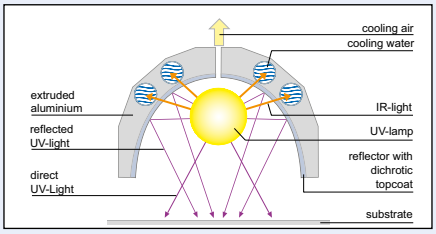
Acrylic substances in the form of monomers or pre-polymers (short-chain molecules) containing terminal double vehicles that interlace into long-chain polymers are used in the radical polymerization process. During this process, the binding vehicle assumes the functions of bonding, color transferability in the printing machine and pigment wetting. The most critical role to be handled by the binding vehicle is the generation of the hardened UV printing ink film. During the hardening reaction, short wave UV light divides the photo initiators into highly reactive radicals that react with other ingredients of the formula. Consequently, the photo initiators are one of the prerequisites for the creation of a cured film. The radicals react with the double vehicles of the binding vehicle composites. As a result, the vehicle itself becomes a generator of radicals and binds itself to other binding vehicle molecules. This process initiates a chain reaction during which over time more and more binding vehicle molecules combine into a three-dimensional network structure. This chemical reaction is called polymerization and occurs within fractions of a second.

2. Cationic reaction mechanism:

As a rule, the binding vehicle systems of cationic UV inks consist of cyclic epoxies. However, the photo initiators do not generate any radicals under UV radiation. Positively charged acids develop instead. These are called positive ions. When these positive ions attach themselves to binding vehicle molecules they transfer a positive charge, which is always further transferred. A chain reaction begins and a network is created. After it is complete, a hard UV printing ink film remains.

UV ink that cures through cationic reaction generally shrinks less than radically hardening UV systems. As a result, they have a strong impact on the adhesive properties on many polymer foils as they achieve better adhesion rates. Thanks to the critical post curing process the risk of migration and the development of odors of unhardened base materials is substantially reduced. Due to these properties, cationic process curing UV printing ink is frequently used in food-related applications.

An optimally performing UV system must be composed of numerous well coordinated components. To warrant the effective curing of UV printing ink uses highest quality UV drying equipment that is serviced continuously. The UV wave length range covers a spectrum of 200 nm – 400 nm. What we use is high energy short wave radiation in the realm between visible light and x-ray radiation.



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