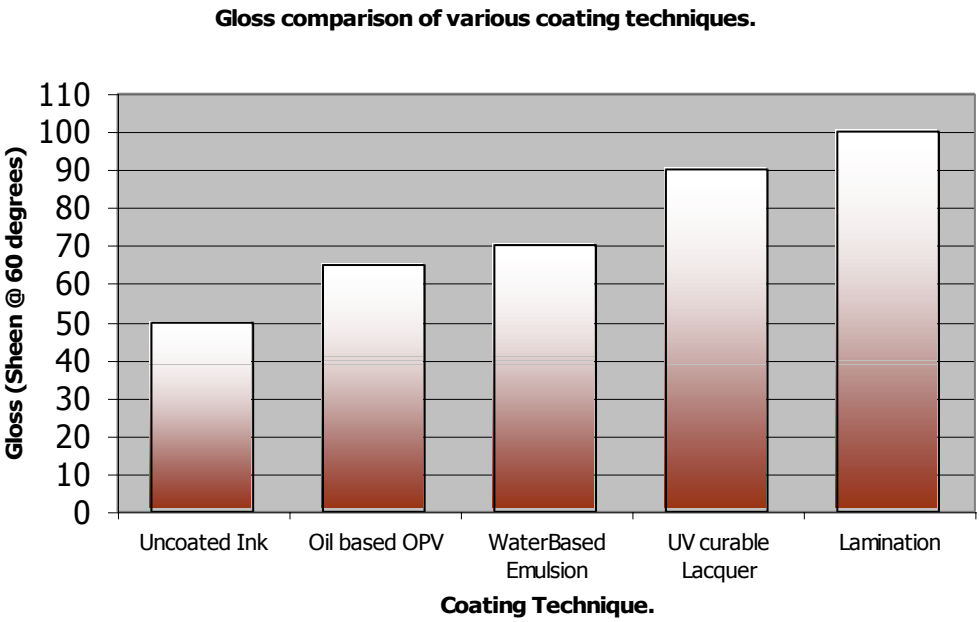
Graphic art.

Introduction

UV Curable products specifically designed for application via lithographic printing machines were introduced during the 1960's. UV technology was of interest to the print industry as it offered the printer much faster processing of the sheets after printing, compared to air dried oil based systems.
UV curable lacquers can be applied using a wide variety of print process e.g. dedicated coater, anilox, duct, modified damper, screen etc and can increase the value of the printed product in a number of ways (aesthetics, chemical resistance, slip, special effects etc.)
The gloss of a UV Lacquer is the highest of all current products available to the printer, excluding lamination.



(These results are based on standard film weights when printed on a common carton board and measured using a gloss meter at 60^0).

UV lacquers dry (cure) almost immediately once exposed to UV light, therefore giving printers the flexibility to run presses at high speeds, even on heavier stocks, and without the use of spray powder or the concern of blocking.

UV curable lacquers benefit from high gloss levels, rapid cure speeds, excellent adhesion to a number of substrates, and almost immediate handling of printed work. Resistance to a number of chemicals, and improved pressroom conditions, make UV products an important consideration when purchasing a new press or sending work out to trade houses.

Formulation

Understanding the composition of UV Lacquer and the precise purpose of each constituent part can be a significant advantage if faced with a problem on press. This section aims to provide a basic understanding of the building blocks used in producing a UV Lacquer.

UV GLOSS OPV

Polymers	30 – 70%
Monomers	30 – 50%
Amine (Acrylated or Free)	8 – 10%
Photoinitiator	4 – 10%
Levelling/ slip additives	1 – 2%
Wax	1 – 2%
De-foamer	0 – 1%

Polymers – High molecular weight products with a large molecular weight distribution. This is the backbone of the UV Lacquer. It provides the main physical characteristics of the final product (cure speed, adhesion, flexibility, toughness, colour, gloss, cost).
The main types of polymer used are:

- Epoxy Acrylate
- Polyester Acrylate
- Polyether Acrylate
- Urethane Acrylate

Monomers – Low molecular weight products with a narrow molecular weight distribution, used to reduce the viscosity of the Lacquer. It will also influence many key factors such as cure speed, gloss, adhesion etc so careful selection is essential.

Photoinitiator - The photoinitiator as its name suggests starts (initiates) the reaction on exposure to light (photo). On exposure to the correct wavelength of light (usually 200 – 400 nm generated by a medium pressure mercury arc lamp) the photoinitiator absobs the UV energy, initiates a chain reaction, which chemically crosslinks the polymer to create a hard dry lacquer.

Amine – Some formulae require the inclusion of an amine to facilitate fast cure.

Leveling/slip additives – Usually based on polysiloxanes are used to aid the wetting of lacquers which results in a higher gloss / smoother lacquer.

Wax – These waxes provide improved slip as opposed to rub resistance. In order to achieve successful overprinting it is important that wax levels do not exceed certain levels, and that the correct wax is employed.

Defoamer – Any prolonged agitation of a lacquer (long term circulation through the press, chambered doctor blade systems etc) can lead to the generation of foam. The build up of foam in a lacquer can lead to the lacquer bodying up. This in turn may cause problems such as pinholing or duct over flows. The addition of the correct defoamer should stop this from happening.

A Printer's Guide to using UV Lacquer

UV curable varnishes can be applied by in-line dedicated coating units, off-line by roller coat, screen or even via the inking or damping units on spare inking stations. Each method of application presents its own unique challenges to the formulator and the printer.

Cure

UV lacquers require a suitable light source in order to initiate the curing process. Medium pressure mercury lamps placed strategically along the press provide this source. It is however important that the lamps are maintained and that the positioning is suitable.

Lamps can be positioned either at the end of the press after application of both ink and varnish or interdeck between units. The exact positioning will generally depend on the type of work being produced, with relatively straight forward

commercial work benefiting from lamps positioned solely at the end of the press, and more demanding work such as printing onto metallised papers and vinyl's, benefiting from interdeck lamps.

When the lamps are set correctly, problems with cure, will generally relate to the substrate, or ink film weight beneath the lacquer.

Impervious substrates such as foils and vinyl's, will require a specialist lacquer, with conventional lacquers resulting in poor adhesion. In the case of such a substrate being involved, it is recommended that tests are performed in order to determine suitability.

Heavy ink film weights and dark colours (which will absorb UV light) may result in impaired curing, which if anticipated may be overcome with the use of specially formulated faster curing inks, under colour removal, slower press speeds, the use of interdeck lamps, or higher cure specially formulated lacquers.

Gloss

Problems relating to gloss are rare and are generally related to unrealistic requests. UV lacquers printed over conventional inks are not recommended as this will result in sub-standard finish, with the level of dry back being severe.

Orange Peel

Orange peel is the name given to the 'wavy' result achieved when the film weight of lacquer, which has been applied, is too high. This can be the result of incorrect viscosities, or exaggerated application.

Excessive film weight of lacquer can lead to insufficient flow out, and can therefore be remedied by a reduction in viscosity, film weight, or press speeds, therefore increasing flow out times.

Presses equipped with extended deliveries will be less prone to 'orange peel', as the lacquer is given more time in which to flow out prior to being cured.

Foaming

In order to overcome such a problem, it may be necessary to make an addition of de-foamer, although it may also be beneficial to turn off pumps during make ready and therefore reduce the initial generation of foam.

Shrinkage

During the process of curing, UV lacquers will undergo a certain degree of shrinkage. In some cases this could be as great as 20%. Shrinkage as severe as this can result in substrate curl, which is more likely to occur on low grammage materials.

Cracking and Flexibility

Certain UV lacquers will be more susceptible to cracking than others either due to the way the product has been formulated or due to over application of the coasting. Ensure a product with good flexibility is used at low film weight .

Colour Bleed

Not all Pantone inks and matchings are suitable for use when work has to be UV varnished. The following colours may fade or alter dramatically when lacquered, especially when concentrations are low – i.e. Tints.

Yellowing

A result of the curing process, is for the lacquer to obtain a yellow appearance. In general this yellowing will reduce after a matter of minutes, although low quality and highly absorbent stocks, will retain more of the discolouration.

Lower yellowing varnishes are available if such a problem becomes apparent. An alternative would be to apply a waterbased primer therefore sealing the substrate and resulting in substantially lower yellowing when UV is applied either off-line or on the second unit of a double coater.

Odour

Fully cured UV Lacquers are generally low in odour, however products with very low odour can be formulated for special requirements.

Candling

Associated more with off-line varnishing, candling will occur when inks have not been given sufficient times to dry or solvents have been retained either by unsuitable packaging or inks. ‘Candling’ is the term used to describe the easy scratching of the lacquer after application, and is so-called due to similarities between scratching the wax of a candle

It is important when sending work out to trade houses to ensure the ink has had at least 24 hours to dry, and has not been shrink wrapped or tightly packed therefore restricting the release of solvent.
If a problem is observed, it will be neccesary to air stacks and give the ink an increased period of time in which to dry.

Reticulation

Prior to printing work which is to be subsequently UV varnished, it is important to check with the ink manufacturer that the ink is suitable for such an application.
Inks with very high levels of wax or solvent, can result in UV reticulation, which cannot be remedied and will require the job to be re-printed with suitable inks.
Reticulation is the word used to describe the unwillingness of varnish to sit over the ink, and is also known as rejection. Reticulation is related to surface tensions, which can be measured using special dyne pens.

Other Factors

Depending on the work type, some jobs will require such finishing operations as foil blocking, embossing, glueing, etc. On such occasions, it is essential that the lacquer is known to be suitable for such finishing, as a special product may in fact be required.
When using foil blockable or glueable varnish, it is important that pumps, troughs and other piece of equipment used for application are thoroughly cleaned. This will prevent any contamination from other lacquers, as even a small amount of contaminate material can interfere with foil/glue adhesion.