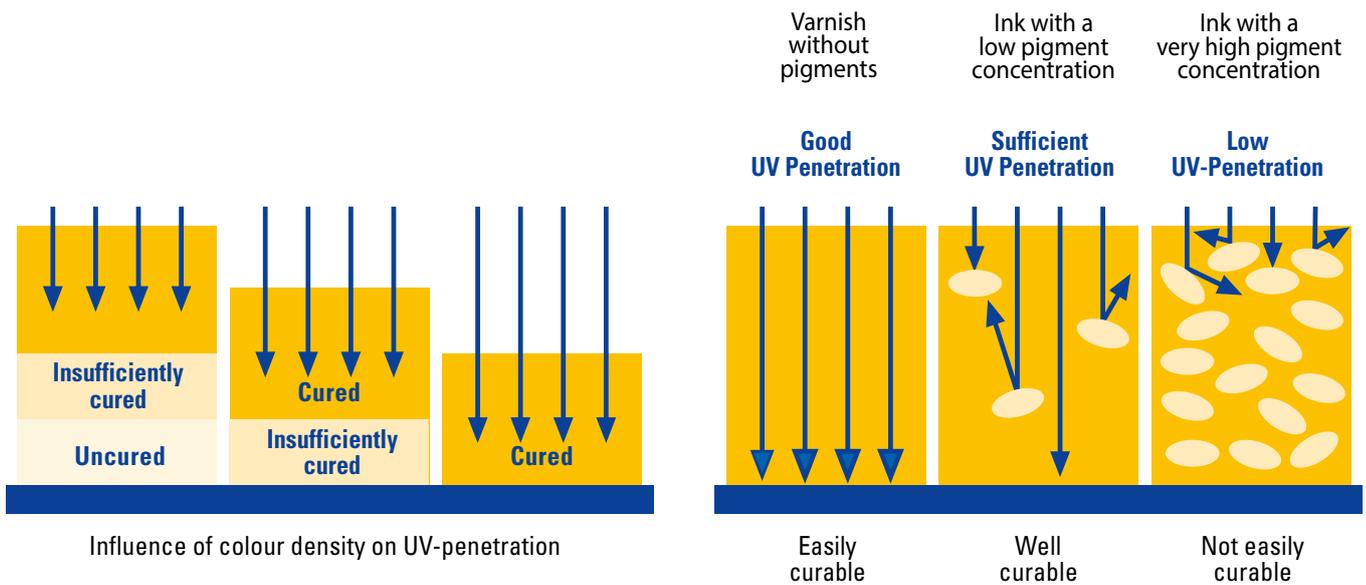




Martin Kremmeter
Laboratory: UV- Ink Systems

CURING OF UV-INKS

Understanding the Technology



»» Curing of UV-inks is a complex interaction of various factors. Printers should be well aware of these individual factors and their effects to avoid problems when handling UV-inks. A sound basic know-how of this technology will help printers to better evaluate the possibilities and comprehend the limitations of the UV-curing process. ««

BASICS OF RADICAL POLYMERISATION

Most UV-inks on the market react according to the principle of radical polymerisation. Binders of UV inks generally are a composition of reactive highly viscous oligomers and low viscous monomers. There are double bonds at the ends of these molecules which initiated by radicals can poly-

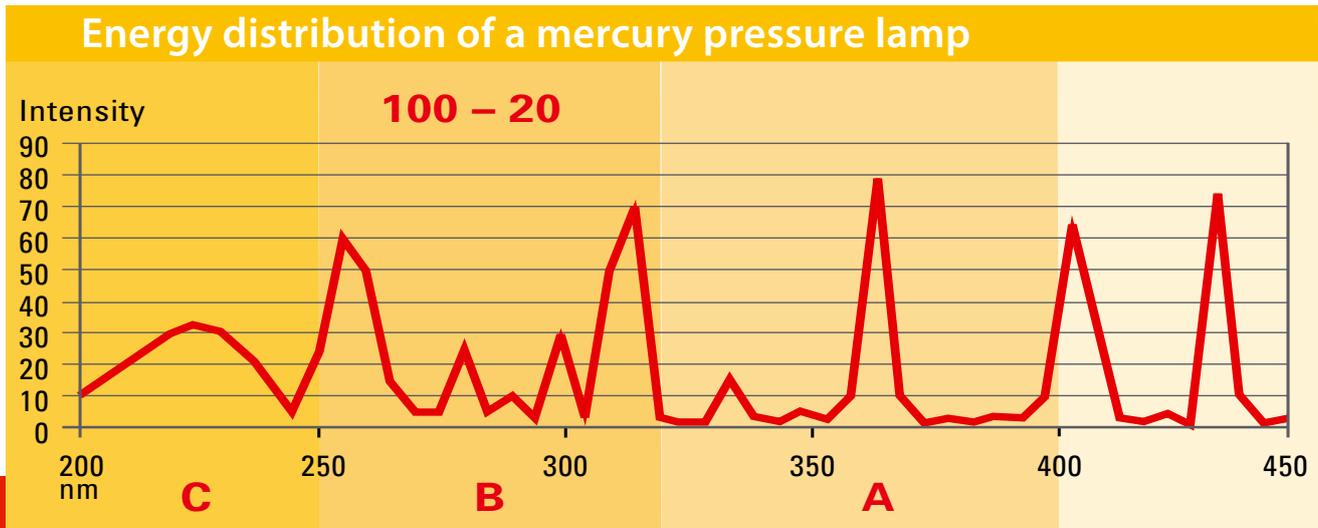
merize and form long chains. Practically a liquid ink layer will form a firm and solid ink film within seconds.

The radicals are produced by the photoinitiators contained in the inks. Subjected to sufficient light of the correct wave length the initiators decompose into

radicals. These radicals then initiate the polymerisation of the double bonds.

Suitable UV light is usually generated with mercury medium pressure lamps emitting a UV spectrum with a wave length of 215-400 nm.

FACTORS INFLUENCING THE CURING



RADICALS ARE A NECESSITY!

Some printers believe that a short activation of the reaction would be sufficient to obtain a complete polymerisation all the way down to the bottom of the ink layer. This, however, is incorrect. The radicals developed by the decomposed initiator are quite unstable. They can only initiate a very limited reaction before they wear themselves off due to a termination reaction. Therefore, radicals must be generated within the complete ink film. This can only be achieved, if the UV light penetrates the complete printed ink film. However, this penetration strongly depends on layer thickness and pigmentation of the ink.

PIGMENTATION AND LAYER THICKNESS

Clear UV varnishes with no pigmentation are easy to cure. The UV light penetrates the complete ink film and polymerisation is initiated in the upper as well as lower ink layers. Therefore, even UV relief varnishes with a high layer thickness can be cured easily.

Process colours with a low pigmentation are also quite easy to cure. With coloured inks and their increased pigmentation the layer thickness applied will have an increasing influence and the penetration of the UV light is more and more inhibited.

Inks with insufficient deep curing will remain waxy or even

fluid and will therefore not show any adhesion at all. However, penetration cannot be increased using more UV-light. Therefore, any ink layer must only be applied in a thickness the UV-light can completely penetrate.

This mainly applies to opaque colours as complete UV penetration is highly inhibited by the increased pigmentation of the highly opaque pigments.

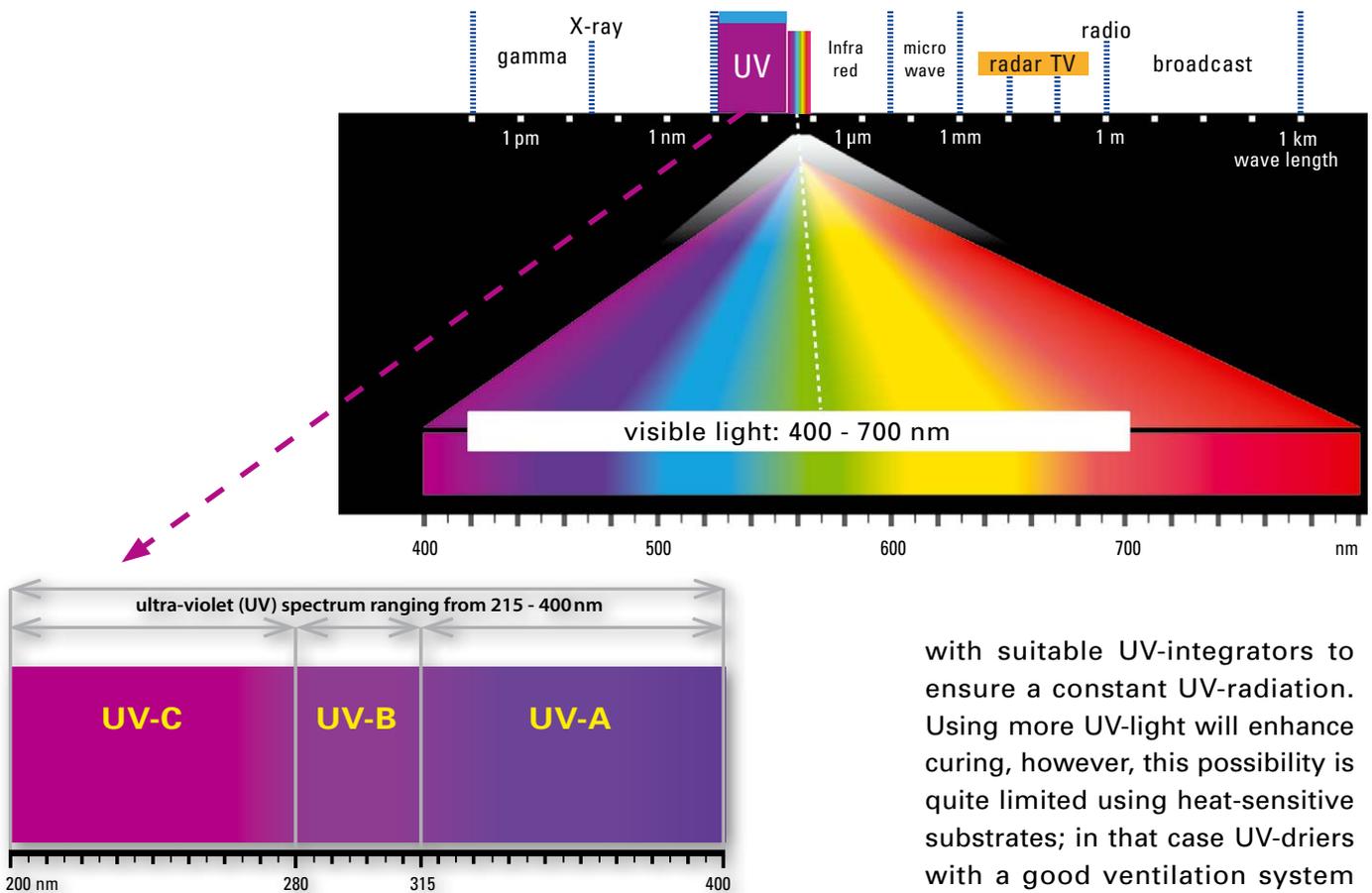
In addition, you should maintain a constant layer thickness for the whole motive. Exact machine adjustment, smooth and non absorbent substrates are required.



mercury vapour lamp

INFLUENCE OF COLOUR ON CURING

Coloured pigments in interaction with UV-light



with suitable UV-integrators to ensure a constant UV-radiation. Using more UV-light will enhance curing, however, this possibility is quite limited using heat-sensitive substrates; in that case UV-driers with a good ventilation system may help.

It's not only the layer thickness that is important, the colour shade used also plays an important role in the curing process. Just like photoinitiators the pigments interact with the UV-light and may absorb this. Black pigments for instance absorb a lot of light whereas white pigments scatter the light.

Ink manufacturers need to formulate ink ranges with similar good curing properties for all colours of that range. That requires careful choice of photoinitiators and the right amounts of pigmentation.

Substrates used also influence the curing, white substrates are ideal as they scatter the UV-light much better than dark ones.

ADDITIONAL FACTORS

What is really important?

The quality of the resulting UV-curing also depends on the type of UV-drier used. There is quite a variety of different curing equipment.

There are units with varying numbers, types and efficiencies of UV-lamps. Also the type of reflectors used (focussed or scattering radiation) and possible belt speeds may vary significantly.

The crucial factor is, that a sufficient amount of UV-radiation has to reach the ink film to achieve adequate curing. The dose should be measured for each application

CONCLUSION

Completely cured ink?

Only completely cured inks show sufficient adhesion, provided the ink system is applied on suitable substrates.

However, the most crucial question will always be: has the ink film been cured sufficiently?

Unfortunately printers still only have two practical options to help answer that question: finger nail test and cross-hatch tape test. If both tests show positive results, the ink generally has been cured sufficiently and will then also show the required adhesion on the substrate.