

04/06

SUCCEEDING WITH UV COATINGS & ADHESIVES

In the past, we have written about the importance of UV chemistry, substrates, wetting, surface tension and curing essentials with respect to optimizing results. Targeted properties can only be obtained repetitively when attention is paid to the details.

We've also written about flexible packaging before and it remains one of the fastest growing sectors of the graphic arts packaging industry.

Flexible packaging substrates vary widely. They may be fabricated of laminated layers of mono-ply films, foils and paper, including metallized film and paper. They may also be films constructed of multi-ply plastic co-extrusions. Still, others may be single layer mono-ply films that can be enhanced with clear oxide barrier coatings or metallization.

The plastics commonly utilized, HDPE, LDPE, PET, PS, PP, PVDC and nylon are non-absorptive and offer little in coating, adhesive and ink mechanical anchoring properties. Paper and board substrates, on the other hand do offer good anchoring potential as a result of natural porosity.

Paper, paperboard and corrugated play a large role in rigid packaging, but plastics are becoming a player here too. Paper and paperboard are being laminated with metallized films as a glittery enhancement.



Photo courtesy Capri Pkg.

Rigid plastics are also to be found in use in the fabrication of folding cartons. Lenticular materials, eye popping as they are, with their ability to produce motion when viewed, are another plastic substrate making a rigid packing appearance.

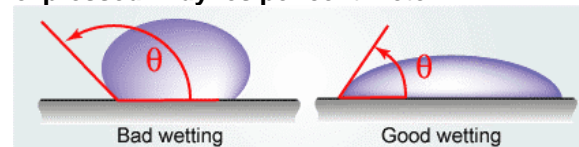
Flexible packaging product applications include pouches and bags, some of which are

now being formed from laminated substrates, that are using 100% solid UV adhesives.

When using UV adhesives, coatings or decorating on these substrates, consideration must be given to the ability to achieve **surface wetting**. Successful wetting is accomplished when the surface tension of the coating, adhesive or ink is lower than the surface energy of the substrate. Also, the surface tension of any coating or adhesive must be lower than that of any underlying printed ink.

When these parameters are not met, proper surface wetting cannot be accomplished and adhesion suffers.

Possibly the most important factor to consider in applying coating, adhesives and inks to substrates is **surface tension**. All liquids and solids have a measurable surface tension expressed in dynes per centimeter.



Good to excellent substrate wetting is essential to acceptable performance. This is especially true when working with non-porous substrates.

When considering porous substrates, a certain amount of mechanical interlocking can occur when a UV adhesive, coating or ink is able to penetrate into a substrate's surface pores, holes or other cracks and crevices, so as to physically hold. Paper surface smoothness and hardness can affect porosity and must be considered for its potential to affect surface wetting and ultimate adhesion.

Non-porous plastics typically have low surface tension and they must be treated to effectively raise surface tension to 40 dynes/cm or higher. Commonly, non-porous plastic film substrate suppliers treat their production using an

oxidative treatment; corona discharge, gas flame treatment, and plasma or chemical. Unfortunately, these treatments have a short lifespan and the oxidative enhancing effect is dissipated in a short time span.

It follows, that in-line treatment (at the time of using UV adhesives, coatings or printing) is the only sure way of controlling a substrate's surface tension converting range. Some substrates are primer coated to achieve an acceptable dyne level.

As discussed earlier, the surface structure of non-porous plastic substrates typically does not yield any benefit in the mechanical anchoring of UV adhesives, coatings or inks. However, there are some textured surface plastic substrate materials that offer some benefits in mechanical anchoring. Also, it is a fact that some UV formulating raw materials can cause some plastic substrate materials to swell, or be attacked to the extent that a stronger adhesion bond results.

UV adhesives, coating and inks must be formulated properly in order to produce optimized cure results. Raw materials must be selected so that acceptable wetting and adhesion will result.

Formulation cure speed must be matched to the available curing line capability. UV adhesives, coatings and inks must be effectively cured not only at the surface, but also through the 100% solid wet film to the bottom. Good acceptable adhesion can only be achieved when this criteria is met.

Proper UV curing, converting line energy must be available and be matched to the formulated adhesive, coating and ink products in order to achieve acceptable results. UV converting line conditions must be maintained to assure proper lamp curing energy output, focus, reflector efficiency, heat management, etc. UV adhesive, coating and ink application thickness standards must also be maintained to guarantee success.

UV chemistry used in the graphic arts is fundamentally of two types. By far the most dominant is free radical, acrylic-based energy curing chemistry. The second, albeit, more expensive chemistry, utilized is cationic, epoxy-based energy curing chemistry.

There are naturally advantages (pluses) and disadvantages (minuses) to each. Comparing we find the following:

FREE RADICAL SYSTEMS

- + Large raw material pool availability
- + Relatively fast cure speed potential
- + Cure speed not affected by RH%
- + Lower cost than Cationic chemistry
- + No dark cure after initial UV exposure

- Higher Polymer shrinkage
- Cure inhibited by oxygen
- Shorter shelf life
- Greater polymer shrinkage after cure
- Draize values need to be watched

CATIONIC SYSTEMS

- + Adhesion to non-porous substrates
- + Cure not inhibited by oxygen
- + Low polymer shrinkage after cure
- + Dark cure after initial UV exposure
- + Very low Draize values

- Cure speed affected by RH%
- Slower cure speed
- Fewer raw materials available
- Higher cost
- Odor generated during cure
- Cure inhibition by amine & moisture
- Benzene generated during cure

Cationic systems undergo very little shrinkage while curing and exhibit excellent flexibility. This combination produces good adhesion to non-porous substrates. These properties would seem to make cationic UV ideal for flexible packaging, but free radical systems continue to dominate.

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