ACTEGA Kelstar Technical Bulletin
Substrate Concerns with UV Coating

As the use of ultraviolet (UV) curable coatings increases in the Graphic Arts industry, so does the variation in substrates on which they are applied. Every substrate that is used not only affects the performance of the ink that is printed on it, but, directly and indirectly affects the performance of the UV curable coating that is applied to it.
The two major concerns about a substrate that affect the performance of a UV curable coating are: **oil absorption** (typically an indirect effect on the UV curable coating), and **porosity** (typically a direct effect on the UV curable coating).

Oil Absorption: Substrates, typically paper or paperboard, have some degree of oil absorption – the quantity of and time it takes "oils"/liquids to absorb into the substrate. If a substrate has a very high oil absorption (i.e., either a large quantity of "oils"/liquids absorb, or absorb extremely quickly), generally, UV coating adhesion to the underlying inks is retarded. This observation is typically not noted immediately after application and curing of the UV coating. It is typically observed after several hours – when the "oils"/liquids that have absorbed into the substrate start to leach out. The "oils"/liquids will leach out in every direction. Those that 'rise up' through the ink will meet the ink-to-UV coating interface, and detract from the UV coating adhesion to the ink.

Conversely, substrates that have a very low oil absorption do not allow appreciable quantities of the ink and "oils"/liquids to absorb. As such, when these printed substrates are UV coated, there are two possible adhesion problems that can occur. The first problem is that the inks will not have acceptable adhesion, and, nor will the UV coating on top of those inks. The second problem is similar to the first scenario presented: an excessive amount of oils/liquids will be on the surface of the inks, and that will interfere with UV coating adhesion.

Porosity: Compared to aqueous based coatings, the raw materials used in UV curable coatings have a much lower molecular weight (the molecules are smaller). As such, in the liquid form, aqueous based coatings are much less susceptible to absorbing into a porous substrate, such as an uncoated litho sheet, and thus, aqueous based coatings perform better as "sealants" for those type of substrates than do UV curable coatings.
When a UV curable coating is applied to a substrate that has a higher than 'acceptable' porosity, the result will be that at least some portion of the UV curable coating absorbs into the substrate, leaving a 'blotchy'/'mottled' look. This look will be most prevalent over unprinted areas of the substrate. It may also be observed over very light ink coverage areas. Typically, in heavy ink coverage areas, the UV curable coating will be able to 'sit-up' on the ink/substrate well enough that a smooth, consistent look is observed.

Also of note are low gloss UV curable coatings, which have been historically matted down with a solid particulate (i.e., silicas). When those coatings are applied over substrates with high porosity, the liquid portion of the UV coating will absorb (as noted above), but, a high concentration of the solid particulate will not absorb. As such, the cured coating will look 'blotchy'/'mottled', and, on the surface, there will be a layer of the solid particulate that can we wiped off.

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To overcome a substrate with a higher than acceptable porosity, several steps can be taken:

Increasing the UV curable coating viscosity. By increasing the viscosity of the UV curable coating, the coating will be more resistant to "flow"/absorption into the substrate. This step typically has limited results, as, a UV curable coating viscosity can only be increased so far – above that point, if the coating is not too thick to be handled by the equipment, it can start to exhibit poor flow characteristics like orange-peeling.

Application of a primer/size coating to the substrate. This step yields excellent hold-out results of the ink(s) and UV curable coating. However, typically due to application, time, or cost constraints, this process cannot be done.

Changing the substrate. Different paper substrates, for example, have either different clay coatings, or different amounts of a clay coating. Changing to a less porous substrate is usually the most effective method of resolving porosity concerns, as they relate to the hold-out of a UV curable coating.

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