PRINTING ON CLEAR PLASTICS

Successful printing on plastics requires focused attention on the entire printing system. The operating latitude for plastic printing differs from paper or paperboard printing. In this paper, we will discuss the technical aspects of storing, treating, handling, and ink selection in order to optimize the plastic printing system.

DIFFERENCES BETWEEN PLASTIC AND PAPER

- The see-through quality of a clear plastic carton provides the obvious advantage of 3-dimensional product visibility, as well as package appeal.
- Plastic and paper require different primers, inks, fountain solutions, and overprint coatings.
- Clear plastics can utilize various ink concentrations to provide consumer appeal through visual effects, including translucency, frosty appearance, and combinations of opacity and window clarity.
- Plastics will not lose shape or break-down in the presence of high moisture or wet conditions.
- Plastics can be clear, translucent, or opaque to cover all aspects in display options.

PLASTIC SELECTION

- PVC – Polyvinyl Chloride (clear, transparent, and opaque)
- PET – Polyethylene Terephthalate (APET- amorphous PET; clear and opaque)
- PETG – Polyethylene Terephthalate Glycolized (clear and opaque)
- PP – Polypropylene (homopolymer; opaque)
- HDPE – High Density Polyethylene (milky clear)

PVC is generally considered to be the most versatile substrate in terms of ink receptivity, ease of gluing, and static properties; it is also the most cost-effective choice for clear packaging. PET has become more popular due to its clarity. Post-consumer recycled-content types of PET are now available. PP and HDPE are often considered given their yield benefits (more parts per pound). Printing on PET, PP, or HDPE requires slightly different printing techniques compared with PVC. Specially made primers are typically used for PP and HDPE. Reactive PUR adhesives may be used for joining PET, PP, and HDPE surfaces. PETG bridges the gap in terms of printing and processing relative to PVC and PET. The PETG surface is more ink receptive than PET and responds to adhesives much like PVC. PP and HDPE typically require a surface treatment to promote sufficient ink adhesion. PET offers the highest clarity and aesthetic quality, followed by PETG and PVC. All are available in translucent or opaque options. PP and HDPE are available as opaque offerings only. PVC also offers surface options, from gloss to textured, when considering differentiation in package aesthetic and design.

INK SELECTION

Selecting the proper ink for plastic printing first depends on the type of printing used. Most visual packaging printers use offset or flexo methods. Conventional offset (i.e. oxidizing ink) has been successfully used in the past, but UV printing systems are now by far the most widely used for a variety of compelling quality and cost benefits. UV flexography is also advantageous over older flexo inks. Therefore, we will emphasize UV ink systems.

Given the variety of commercially available UV offset inks and the complicated interactions with print blankets and fountain solutions, we advise that the printer work jointly with ink and substrate suppliers to determine the optimal ink package suited for a specific substrate. Many ink vendors can supply a system that works well with an untreated substrate; alternatively, the vendors can recommend a primer that is suited for the substrate and desired graphics.

For flexo printed jobs, it is equally important to do ink trials to determine optimum conditions, as is the case with different paper and paperboard substrates. We suggest you work closely with vendors to assess the best solution.

Ink suppliers that can assist the plastic printer in choosing the right ink set include: Flint, Toyo, Environmental Inks and Coatings, Sun Chemical, Gans, Wikoff Color, SICPA, Keystone, Siegwerke, Marabu, Huber Group, Epple, Jänecke+Schneemann, Zeller+Gmelin.

In setting up a sheet-fed run, it is important to perform the proofing and the press adjustments with the same substrate intended for the commercial end product.

SURFACE CONSIDERATIONS

Surface energy is commonly determined by use of “dyne” pens or solutions which indicate the surface energy (measure in dyne/cm) of the surface.

For proper ink wetting and adhesion, the ink needs to have at least a 5 dyne/cm lower surface energy than the substrate. Common plastics used in clear packaging have natural “dyne” levels of 34 to 40 dyne/cm. Therefore, it is important to work with both the plastic supplier and ink vendor to arrive at the proper marriage of the technologies to achieve optimal ink application.

Many plastic printers have found ink systems that work well without any special treatment of the plastic surface, but other printers chose to ensure good ink adhesion by using specially treated plastic film or by applying primers.

The most common surface modification is corona treatment. Film manufacturers have the ability to raise the inherent surface energy by application of an electric arc (corona) that generates relatively more polar (i.e. higher surface energy) surface species that are receptive to ink wetting. Both sheet and roll stock can be corona treated by the film producer. Under ideal conditions, the film is treated both by the manufacturer and by the printer immediately before printing. This is best accomplished with roll stock used in flexo printing, as corona treatment of film sheets is expensive and difficult to perform routinely. Before specifying corona treatment, however, the printer should determine the optimal surface energy necessary for the specific inks used.

It is important to note that the dyne level of a treated film diminishes over time and is dependent on many variables. Certain substrates like PVC tend to maintain corona induced surface energy longer than APET or OPET. The transportation and storage conditions of a treated film can also cause rapid degradation of initial surface energy. In general, high temperature and low humidity conditions should be avoided to minimize a drop in dyne level. To maintain reproducible results due to corona treatment, it is best to use film in a first-in first-out manner.

While corona treatment often provides the margin of success for ink adhesion, it can present other problems. Overtreatment to levels of greater than 50 dyne can actually result in poor ink adhesion. Plastic with an excessive surface energy also tends to block more and has problems transporting through a sheet-fed press. Some films, especially APET, will tend to scratch more readily when corona treated.

STATIC CONTROL

Since all plastics are insulators relative to paper, static charge buildup may manifest itself in sheet-fed operations unless proper process conditions suited to plastic are implemented. The inherent physics generating a static charge when separating two insulators—such as feeding sheets from a pallet into a press—must be dealt with to avoid the following problems:

1) the safety issues of static discharge;
2) patterning in inks and coatings;
3) dust and dirt attraction that promote scratches and print hickeys; and
4) feeding issues including blocking and double-feeds.

Good static mitigation starts with film storage and acclimation. The film stock should be stored under the same conditions as the press for at least 24 hours. The press room itself should be at 72°F and have a relative humidity above 40%. This high relative humidity will help prevent sheet stock from blocking–for easier feeding–and it will also assist in static charge decay. Good control of humidity will aid in sheet handling, and also minimize static attraction of dirt and debris.

"Flipping" or turning a pallet with the assistance of fanning the sheets with ionized air serves to condition the sheets and also blows off any debris or dirt that may have been attracted to the film. Manufactures of reliable devices include Busch and Automatan.

Further static prevention is found in both passive and active systems. Passive measures must include grounding the press at multiple points. Additional methods include static string, tinsel, and static bars; these devices remove static charge through contact with the film. An essential active system for sheet fed presses is an ionized air blower that can be directed to the top sheets of a pallet as the sheets are being picked up.

OTHER CONSIDERATIONS

Clear plastic substrates, like most high-gloss surfaces, can be susceptible to scratching and marring. There are simple measures the printer can follow to minimize this problem for any substrate with high surface aesthetic requirement.

- Ensure that the roll or sheet stock is properly packaged to minimize film movement during transit and keep the film in its original packaging until press time.
- Roll stock should not be rolled on the floor; rather, it should be moved with forklifts or other powered equipment.
- Pallets should not be double stacked unless the packaging is designed for this purpose.
- Finally, any hard or rough surface that will contact the film in the printing process should be covered with moleskin.

Much like the yellowing effect various substrates experience under intense UV exposure, all clear plastics mentioned above have some propensity to become adversely affected by such exposure, potentially leading to brittleness or yellowing. PVC is most resistant while PET is most susceptible to UV embrittlement. Therefore, it is important to minimize overexposure while still getting sufficient UV photons to achieve sufficient surface and through-cure of the inks. Balancing UV exposure will also minimize any distortion of sheet or roll stock that is a result of the heat that accompanies the UV curing. Two ways to prevent over-curing and distortion are to use dichroic reflectors and vectoring software for plate layout. Dichroic reflectors will absorb the infrared energy emitted from the UV bulb to prevent the heat from being absorbed by the plastic film. Vectoring software compensates for sheet distortion due to heat.

SUMMARY

High-quality printing on plastics routinely produces enhanced 3-dimensional visibility in graphic packaging, and is attainable through a variety of methods using a range of ink and coating technologies. Each type of film has unique properties which must be considered when specifying printing method and ink formulation.

The careful printer will be aware of the printing challenges plastics pose, and will address them early in the development process. This is best accomplished by having a strong communication network with raw material and equipment suppliers.

Plastic material options provide versatile appearance solutions that combine product visibility and exterior package graphics enhancement in ways opaque materials cannot.

Klöckner Pentaplast Group
The Americas:
3585 Klöckner Road
P.O. Box 500
Gordonsville, VA 22942 USA
Phone: +1.540.832.3600
Fax: +1.540.832.5656
www.kpfilms.com
kpainfo@kpfilms.com

Klöckner Pentaplast Group
Europe:
P.O. Box 1165, 56401 Montabaur
Industriestr. 3-5, 56412 Heiligenroth
Germany
Phone: +49 2602 915-0
Fax: +49 2602 915-297
www.kpfilms.com
kpinfo@kpfilms.com

Klöckner Pentaplast Group
Asia:
64/48 Moo. 4 T. Pluakdaeng,
A. Pluakdaeng, Rayong 21140
Thailand
Phone: +66 38 927400
Fax: +66 38 955462
www.kpfilms.com
kpinfo@kpfilms.com