Selecting Core Material – More than Meets the Eye

By Tom Mucenski, Klöckner Pentaplast of America, Inc.

Proper core stock selection is relatively easy once you understand some basic PVC characteristics and several key processing parameters within the card-manufacturing environment. To best match finished card performance, ease of processing, and economical purchase of core material, one needs to gather basic information on the specific print process used; type of card construction; and the lamination parameters.

The first assumption that needs to be made is that the film supplier is offering substrates that meet ISO card standards as outlined in ISO 7810 and tested to methods described in ISO 10373. Quality film suppliers will have internal data confirmed at an outside test laboratory. The most known test facility in this hemisphere is Eclipse Labs in Bloomington, MN, USA.

Printing processes (UV, conventional litho, or silk screen) are dictated by the end customer's graphics requirements and the print equipment at the card manufacturer's facility. The type of card construction (solid core or split core) is also dictated by printing press capability, specifically the substrate thickness range of the press. The end use of the card and/or the lamination settings determine the type of material to be used – homopolymer versus copolymer film. Conversely, the material chosen by the card manufacturer (homopolymer or copolymer) will determine the lamination settings required to attain the proper core-to-core bond. Homopolymer core films require hotter and sometimes longer lamination settings particularly for split core applications. Copolymer core films can be laminated at lower temperatures and some times shorter cycle times. Lamination of copolymer core films at lower temperatures can also help minimize "ink color shift" or in "burn out."

The film supplier then takes the above card process information and translates them into the most cost effective use of PVC film through the proper selection of the film's properties to include VICAT points, opacity (color), surface roughness, and specific gravity. These factors become the foundation for "Core Selection 101."

VICAT

VICAT is the temperature at which plastic begins to soften. Productivity and card performance can be greatly affected by the VICAT of core film.

Printing presses often limit the thickness of film that can be processed. Thus when print presses have limitations of 400 microns thickness or less, split core construction will be used to produce finished card product. This means printing the front and back of the card on two separate opaque white sheets. The sheets are typically 12 to 13.5 mils

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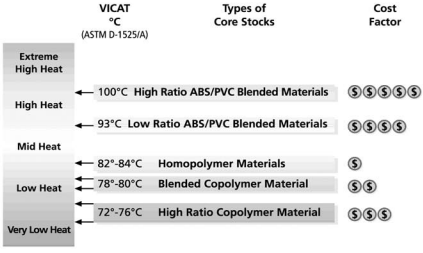
VICAT Chart



each and are solidified during a subsequent lamination process that normally includes the application of a clear overlay film (1.6 to 3 mils) on each side to protect the printed graphics. The critical VICAT temperature for split core cards is that of the two core sheets, because the plastic must soften all the way to the center of each sheet or approximately 15 mils. The VICAT of the overlay is less critical.

Lamination is often a bottleneck work center in the card manufacturing process. In order to maximize productivity in a split core card construction environment, it is best to choose a core material that has a sufficiently low VICAT temperature so that the core materials will soften and bond together more quickly. Typically, a high ratio copolymer formulation film is preferred. Such a film requires the least amount of lamination processing time, as well as minimizing discoloration or card flowing that may appear in the card once bonded. On the negative side, copolymer films are higher priced than blended or homopolymer films due to higher raw material cost.

In a solid core construction, the front and back graphics are printed on the same sheet. Typically, solid core film construction uses 24 to 26.5 mil opaque white center with the graphics on each side being protected by 1.6 to 3.0 mil overlay film. Since the only bonding required is between the overlay and core/ink surface, which is typically no deeper than 3 mils on either side of the card, the critical VICAT is that of the overlay which must bond to the solid core material. Therefore, a higher VICAT core material can be used. Typically, this core material is a full homopolymer film. Homopolymer material is the most cost effective film to use in card construction and will allow for a quick lamination cycle to enhance productivity in a solid core construction environment.

Low VICAT blended copolymer materials are basically a hybrid between the two extremes of the high ratio copolymer film and a full homopolymer film. The film supplier is attempting to supply the desirable characteristics of a high ratio copolymer film without having the customer absorb the full cost of such a film. The price point is usually between copolymer and homopolymer.

Of course, the card industry has continually evolved since the early '60's and today specific card requirements include high stress environment material for GSM card and similar products that are met by films with various ratios of ABS and PVC to meet industry standards or customer requirements for VICAT minimums. The future will certainly see the evolution and development of hybrid materials and cards for high-end use as well as increased use of polystyrene and polypropylene on low-end card products.

Opacity

Opacity, not color, is of greatest interest in controlling a card manufacturer's cost. As the chart summarizes, the degree of opacity is directly related to the amount of TiO_2 in the formulation. It is also true that the higher the concentration of TiO_2 the higher the film cost. Thus, it is in the best interest of the card manufacturer not to over specify the requirements in this area. While card construction may have equipment limitations forcing the card manufacturer to seek a more costly split core

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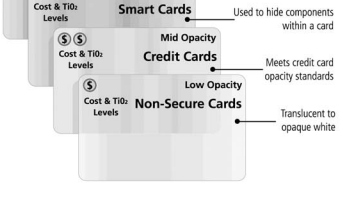
Opacity Chart



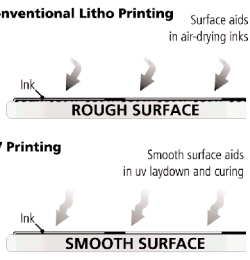
construction, opacity is within a card manufacturer's total control for proper selection. Higher concentrations of TiO_2 lead to higher raw material costs and an increase in specific gravity and thus a higher weight/cost per sheet. From a costing perspective the lower the levels of TiO_2 the more attractive the cost can be. While different levels in TiO_2 do represent up to $ .10 per pound differences in costs, even a slight price advantage of $ .01 per pound would be significant when multiplied by a consumption rate of a million pounds or more of core stock in any given year.

It also should be noted here that opacity requirements on credit card product is for the finished card design and not for the blank opaque card body that will be used in satisfying an order. Most credit cards today are full bleed front and back with extensive use of 4-color process and/or silk-screen inks. Thus, by the very nature of the card design itself, will meet opacity requirements via ink coverage and not blank card opacity.

Surface

Surface roughness is the third parameter that requires consideration. Surface roughness helps ensure that the film can be successfully printed on at the card manufacturer's facility. As shown at right, typical surface roughness is designed either for a UV print process environment or a conventional litho print environment. UV ink is more expensive but less ink is used on a smoother surface. UV ink is also partially cured either between printing cylinders or at the end of the printing press with the aid of UV lamps. Therefore, it makes sense for a smoother surface to be utilized in UV print process.

Surface Chart



Where conventional litho printing is used, a rougher surface is desired to help accelerate the cure time. Often sheets are stacked to a minimal height and allowed to "air-dry" for several hours to several days prior to printing the next pass.

The differences in matte film finishes are controlled as part of the film manufacturer's process. Even though only two types of finishes are noted above, several smoother or rougher finishes can be obtained if required by the end customer. The skilled print pressman at select manufacturing sites may prefer these surfaces. Increased film costs, due to set-up time at the calender, can be expected unless significant volumes accompany each special surface requirement.

Specific Gravity

The higher the specific gravity of core stock film used the lower the yield or sheets/pound. Despite this knowledge, it is amazing how many card companies purchase purely on cost per pound basis. Anytime a company purchases in one unit of measure ($/lb.) and issues inventory in another unit (sheets), yield, impacting cost per sheet, becomes a strategic factor.

In the world of card film manufacturing, product can be produced with the introduction of fillers such as CaCO and/or talc. While this may give the film manufacturer ease of production, it has no or minimal benefit to the card manufacturer. In fact, the use of fillers may result in both a higher specific gravity for the film and lower performance characteristics in card testing such as flex and impact. While the test results may still meet ISO requirements, the costs may actually be higher due to lower yield (fewer sheets/lb).

Fillers, when used, and the over specification of opacity can both significantly increase sheet weight. Non-filled films with proper product formulation and color selection can generate a 1% to 10% yield advantage over its filled counterpart. In effect, a non-filled product that is less opaque color may actually have a higher unit price ($/pound) but may be your best value when calculating yield on a cost/sheet basis. So buyers beware; your best value may not always be your lowest $/lb price.

Conclusion

Proper core stock selection should be a joint decision between card manufacturer and film supplier. An experienced film supplier can aid in providing the most cost-effective selection of film once the final use of product and internal manufacturing parameters/limitations are understood.