Choosing the Right Aqueous Inkjet Media

FineEye is often asked how we evaluate media grades when selecting new products to add to our media line. The following is an edited collection of the most common questions and our responses.

What is the most important factor in determining the quality of an inkjet media?

Print Quality. All other factors aside, the quality of the final print is the only thing that really matters. Unfortunately, this is easy to state, but often difficult to quantify. For the most part, print quality can only be determined by visual analysis. Ask yourself, "Does the print look sharp and in focus? Do I see any defects with how the ink is laying on the surface of the media, especially in the dark areas? Is the color deeply saturated and bright without looking cartoonish?" These questions are a great place to start when evaluating any media.

A more technical understanding of print quality must specifically look at ink absorption and ink stability. Ink absorption is the rate at which the media coating will accept ink. Ink stability, sometimes called ink immobility, looks at how well the ink remains in the correct location within the coating after it is applied. These two factors most affect the clarity and color gamut of the resulting print.

What are the basic components of a high quality inkjet media?

There are a host of chemicals and materials that make up any given inkjet media. All of these are important, but here we will focus on those most commonly discussed when it comes to the quality of a product.

Coating: It should be understood that the term *coating* is applicable to many different processes in creating an aqueous inkjet coated media. For example a base material is often coated with a primer first. It may also be coated with a layer of filler to adjust the whitepoint, thickness or rigidity. Finally a top coating is applied that makes the media receptive to aqueous ink and determines the final finish of the media. Most of the attention in evaluating a media is given to this inkjet receptive top coating.

In the early years of inkjet when dye inks were prevalent, *Cast* coated media was popular. With this type of coating, a heated calendaring process is used while the coating is still soft, creating a high gloss surface. These early inkjet coatings often had poor ink absorption rates, and often struggled to stabilize the ink after printing. The result was poor print quality that changed as it dried and with exposure to air and sunlight. *Swellable* coating replaced *Cast* coating as pigmented inks emerged in place of dye-based inks. This coating surface is made of polymers that swell as ink comes in contact with it. As the vehicle of the ink evaporates, the pigments become captured between the hardening layers of the coating. This coating proved more durable than the *Cast* coating but also suffered from a slow drying time in which the ink stability of the coating was suspect. The coating was also susceptible to damage from water. Later, *Porous* coating became available and is now found with names such as *Microporous, Nanoporous* and others. These coatings are particle based and feature openings where the ink is received before

being absorbed by the particles. This creates a very fast ink absorption rate with a high degree of ink stability. As such, *Microporous* coatings have become the norm for high quality inkjet media.

Coating Thickness: An inkjet receptive coating can be applied to a base material with varied thickness and concentration. This can be achieved by thinning the coating with solvents or water prior to application, by changing the thickness of coating being sprayed, brushed or rolled onto the base during the coating process, or even by coating a media multiple times. A thicker coating often results in a stiffer media, which can be good or bad depending on the application. Thicker coating layers can also improve the smoothness of a media, which often results in a sharper dot and better imaging clarity. As a general rule for high quality photographic, display graphic, and proofing applications, thicker coating is better but usually costs more to manufacture. A thinner coating layer might be required for more flexible media applications where stiffness or cracking can become a concern.

Base Material: The base material used for a media has a big impact on quality of a product. However, this is very much linked to the thickness, quality and type of coating used. A thin, poorly applied coating will have low performance on anything it is applied to. A great coating cannot overcome the challenges of a cheap, inconsistent base material. Keep in mind that almost anything can be sprayed with an inkjet receptive coating. That does not mean the end product will print well. There are four types of base material common to high quality inkjet media.

> *RC Media* (Resin Coated) is predominantly used in high-end photo and proofing stock. Inkjet coated RC base emerged as makers of silver halide coated photo paper converted to inkjet applications. RC base encapsulates a paper layer between two protective layers of plastic. This makes the media durable and provides an extremely smooth surface for the inkjet receptive coating. A good RC media will capture all of the ink in the inkjet receptive coating layer and hold it close to the surface, resulting in a large color gamut.
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> *Fiber Based Paper* is used for most Matte and Bond coated media. Here the smoothness and thickness of the base have a large impact on the quality of the media grade. Smoothness is often achieved by adding fillers to close the natural gaps in the fibers on the paper surface. The fibers of the base material hold the majority of the ink in this type of media, not just the coating as in other products. As such, the ability of the base to take ink without overloading the stock and causing problems is a key factor in determining quality. A thicker coating can help both with the smoothness of the media and its ability to absorb ink quickly. Some fiber-based media may contain a barrier layer to limit the amount of ink that absorbs into the base stock. These grades will take much more ink, but are also much more expensive. It should be noted that some Fine Art coated media technically falls under this category. These Fine Art grades are designed specifically to accentuate rough and textured surface characteristics. The paper is often colored and composed of high cotton or rag content intended to make the fibers visible to the naked eye. The coating on these grades will often allow large amounts if the ink to absorb into the paper to give a softer appearance for artistic effect.

Fabric is increasingly being used for inkjet applications. This can include canvas for artistic applications as well as opaque flexible material used as an environmentally friendly alternate to synthetic banner media. The coating of these bases is extremely critical to quality due to the flexible nature of the fabric materials. The coating must not crack or stiffen the fabric, but also must keep as much ink as possible from the fabric fibers in order to produce a richly saturated gamut. Prints on fabric bases may look dull and washed out if the coating cannot achieve this latter goal.

Synthetic base materials include vinyl, PET films, Tyvek and a variety of waterproof substrates. Similar to fabric materials, the coating must often be very flexible and thin to accommodate the base material and application. In most cases, the coating must capture all the ink because the synthetic nature of the base will repel the water vehicle of aqueous ink.

Surface Type: The available surface type of a media is largely dictated by the base material and coating used. Nomenclature for surface types varies greatly across available products, but in general surfaces fall into one of four categories.

Gloss: This media will have a shiny, highly reflective surface. In traditional silver-halide photo terms, this would be referred to as an F-Surface paper. Typically high gloss media has the smoothest surface, largest color gamut and results in the sharpest image quality. It is often more susceptible to scuffing and damage.

Luster/Satin: This finish is the most difficult to identify as so many products and naming variations fall into this category. You may find media labeled as "Semi-Gloss" or "Pearl" in this category. In traditional silver-halide photo terms this would be an E-Surface paper. The finish typically features some amount of reflective gloss, but the effect is broken up by a bumpy, repeating surface structure.

Semi-Matte: This finish will have some small amount of luster on a smooth un-textured surface. In traditional silver-halide photo terms this would be an N-Surface paper.

Matte: This finish is a smooth surface with no luster or gloss to it. The surface is typical of an uncoated plain paper, but often smoother due to the fillers and coating.

Whitepoint: The white point of a media is defined by the D50/2° CIE L*a*b* measurement of the media surface. The white point of a media is determined somewhat by the base material, but is often created by coloring and brightening the coating itself. Paper specifications will often quote brightness and sometimes whiteness. These measures can be helpful, but ultimately a colorimetric measure of the whitepoint is the most accurate specification of the color of the paper.

OBA Content: Most inkjet media coating will contain some amount of optical brightening agents (OBA's). OBA's allow paper manufacturers to brighten and whiten media without adding significant cost. OBA's convert non-visible UV light it into visible blue light, making the media appear bluer and brighter. The downside to excessive use of OBA's is that they deteriorate with exposure to air and UV light. This can cause a paper to "yellow" over time if not properly protected. Controlled amounts of OBA tend to add the benefit of brightening media offerings without risking too much in the way of deterioration. OBA's have been rightly blamed for 'fooling' color measurement instruments from being able to properly report how a color appears to the human eye. Spectrophotometers and color profiling software have implemented various filters and corrections to combat this very real issue. One approach to resolving this problem has been the introduction of OBA-free inkjet media for proofing. It is important to realize that most press stocks use a considerable amount of OBA content. Selecting a proofing media that has zero OBA's may make it difficult to match these press sheets. OBA content can be measured by comparing a CIE b* measurement on a media both with and without a UV filter on a spectrophotometer. The difference in b* demonstrates the amount of OBA present. A highly brightened media may have a b* difference of eight. A controlled amount of OBA's may only register a change of one or two. For accurate color matching, the rule of thumb with OBA's is to stay away from the extremes. Zero OBA media will not visually match commonly used printing papers that have OBA's. Excessive OBA's may cause problems over time depending on your application. In fine art and photo printing where longevity is required, proper protection from UV light and open air are required to control the impact of the high OBA's used in most photo media.

How can I practically evaluate an inkjet media for use in my application?

The best evaluation of an inkjet media is to produce a print, then use your eyes and some common sense to judge the results. That being said however, there are typical problem areas that should be investigated thoroughly on any media under evaluation. Understood this way, evaluation is often a matter of trying to discover defects. Most media grades on the market will generate a good looking print from a decent RGB image, but you need to test the limits to discover the true merit of the product and where it might fail you. Additionally, there are some quantifiable ways to score one media against another in terms of quality and ability. The following tests are used by FineEye to evaluate and qualify media.

Inking capacity: The ability for a media to take ink quickly, dry fast and remain stable is the number one objective measure of quality. FineEye starts by creating an unlimited calibration through a halftone capable RIP for the media and printer being evaluated. This is important because the default printing methods provided out of the box for a printer or media have ink limits that will not allow you to fully test the inking capacity of a media. Ramps of color in the individual color channels and in overprint colors are printed through this special set-up and then evaluated visually and colorimetrically. The shadow areas of the print are especially scrutinized for over-inking that might indicate a coating that cannot accept large volumes of ink. The ability to hold ink without causing defects indicates a good media. Common defects are gloss differential, ink pooling, bleed-through or lack of ink adhesion. If defects like these occur, this may not automatically disqualify a media because inking can be limited via a calibration or through

profiling. However the severity or lack of these issues can be an important factor in ranking one media against another.

Dry time: Micro-porous coatings are typically "instant-dry," but all coating will demonstrate some amount of drying as the vehicle of the ink evaporates. This event is often called outgassing. A good micro-porous coating will not allow the ink pigments to change or move during this process. It is worth investigating a given media to see if this holds true for your application. Rubbing a solid area of ink with a finger, directly after printing, is a simple test to perform. You can be more scientific by measuring solid patches of color at various time intervals after printing to determine if the color is changing. Fiber based media that uses the base to absorb the ink should be checked for bleed-through. This is where the ink can be seen bleeding though the base and appearing on the backside. This is an indication of over-inking, which can result in extended dry time, deformation of the media surface and color reversals in shadow transitions.

Ink fastness: If the ink is compatible with the media, it should not rub off after printing. The same "finger" test as described in the Dry Time section can be used to determine the ink fastness. Typically problems can occur when Matte Black inks are used on the wrong kind of paper. Matte black inks are often designed for bond or matte coated media. When printing Matte Black on a semi-gloss or gloss surface the ink easily smears even after an extended dry-time.

Bleed: Printing a series of fine lines can help determine if the ink is being properly captured by the media coating. If the ink is allowed to feather into the coating, fine lines will appear too bold or even slightly fuzzy. This is an indication that the coating has poor ink immobility for the ink being use. Another test is to print blocks of all the primary colors flush against each other to see if the inks bleed into one another. Often black and yellow will bleed together if the coating cannot hold the ink properly in the coating.

Gamut: The gamut potential for a media can be evaluated by printing and measuring a profile target or by simply printing and measuring solid primary ink colors for each channel. As mentioned in the inking capacity tests, here too it is important to evaluate the full potential of the media through an unrestricted calibration set of a RIP. Printing through a driver or supplied profile set will not allow you to evaluate the true capability of the media. FineEye uses software to plot these measurements in a three-dimensional color space to evaluate one media against another and against industry standards. Further calculations can be made to quantify the total gamut volume as another comparison tool.

Black point: The lowest possible L* achievable on a media is determined by measuring a series of overprint shadow patches. This indicates, along with white point, the maximum contrast and dynamic range of a media, which in turn is a good indicator of potential color gamut on a media. Here gloss differential comes into play. High quality media will have a consistent appearance as ink is added. Some lower quality media will show a dull haze or matte finish as ink is added, negatively affecting minimum L* values. A low L* value is critical to achieving photographic quality prints and in matching color from one substrate to another. L* values below ten are an absolute requirement for high quality photo and

proofing media at FineEye.

White point: The white point of a media is defined by the D50/2° CIE L*a*b* measurement of the media surface. FineEye typically recommends this measurement be taken using an X-Rite 530 Spectrodensitometer or equivalent. White point cannot be properly evaluated using brightness or whiteness measurements. The L* of the white point can give some indication of the potential gamut of a media in that it defines the whitest possible color achievable. Be careful not to place too much importance on the white point of a media in an attempt to match some other paper stock. Often whitepoint can be simulated if needed in a final print. Far too often a poor quality media is selected over a higher quality media simply because of whitepoint. FineEye will select a media based upon the coating and base material quality first. Whitepoint is typically the last thing specified and can, with large enough volumes, even be changed by the coating manufacturer if needed.

Coating Durability: FineEye tests every media for peeling and cracking by physically stressing the substrate in a variety of ways. Some coatings will crack when folded or bent. Others will flake off the base material if the media is rolled between two fingers. These "defects" may be inherent to a required coating/base application. If so, it is good to be aware of this and handle prints and media appropriately. In many cases this behavior is unacceptable in the final product. Your specific application will dictate the acceptability of the coating durability.

Coating Consistency: FineEye evaluates every media by inspecting it using a UV lamp. Since most coatings contain OBA's, the coating and base material will appear vastly different under UV light. Any inconsistencies in the coating process will appear to the naked eye when viewing the media surface in this way. Inconsistent coating may be an indication of coating that is too thin or applied incorrectly and may lead to consistency issues in print.

Opacity: Certain applications will require a media to have some degree of opacity. This is best tested under the specific conditions of your final product. If proofs will be evaluated atop of one another then show through should be tested in this same manner. If a banner media must be opaque to the eye when set in a stand in front of a window, test this very scenario. Often a media will not be 100% opaque unless a block-out layer has been added to the base material to make it so.

What are some of the common mistakes that are made in evaluating an inkjet media?

There are some common pitfalls that need to be avoided in the process of evaluating a media.

The leading mistake is to evaluate a media using an inkjet printer's print driver. Print drivers will, in almost all cases, apply some level of ink limiting and color management to a file prior to printing. This means you are not evaluating the media alone, but also the quality and condition of the software color conversions.

In this same spirit, it is very critical when comparing one media against another to make sure that all variables other than the media are identical. Use the same test files, printer, inks, resolution, printer settings, and RIP settings.

Additionally, print drivers send RGB color data to the printer while the printer uses a combination of CMYK and other inks for output. Most good color test files are CMYK based in order to evaluate the various ink channels of the printer. If you try to send a CMYK test file through a print driver, it will convert the file to RGB on the fly and the printer will then convert it back to CMYK. In the end you will have a print that does not represent what the printer can do unrestricted on the media you are testing.

A similar mistake is to print on the media using an ICC profile developed for some other media. In this case, the profile is modifying color for the specific characteristics of the media for which it was built. If the media you are evaluating is very different, the results you see may be misleading. For example, a profile for Matte media will often have significant ink restrictions built in to compensate for over-inking. If you used this profile on a gloss media, you would not observe the true potential of the gloss stock.

Another mistake is to disqualify a media based upon the white point alone. This includes a rejection based upon the presence or absence of OBA's. Evaluate a media for the coating and base material quality first, looking at critical items such as inking ability, ink stability and gamut. Find a good media, and then look at the whitepoint. If the whitepoint is unacceptable, consider simulating whitepoint or ask the media provider if other whitepoints are available. At FineEye once we discover a winning coating, we may produce a variety of media grades using different whitepoints on the same base material and coating.

OBA use in media is greatly misunderstood and often treated as a black and white consideration. Never reject a media outright over OBA's. Talk with the supplier and test the media to see if OBA's might potentially help or hurt your intended application.

How can I be expected to figure all of this out when I simply need to select a good media that I can trust and get on with my real job?

This document has been provided as a starting point to help you in media evaluation. FineEye uses these same techniques to review all the media it sells. We have built a reputation in the industry as the "go to" provider of the highest quality media for proofing, photographic and display graphic aqueous inkjet printing. We buy directly from the paper mills, convert all our media in our state of the art facility and bring our products to market at extremely competitive prices. Contact us with any of your questions. We can provide samples, pricing and connect you with one of our certified dealers. At FineEye we pride ourselves in being the experts so that you don't have to be. Our Validation media line is so named because we validate everything from the source to your door. Let us demonstrate our promise of quality, expertise and price competitiveness to you today.