# Inks and Coatings

**Unit:** Work Flow

**Problem Area:** Materials

**Lesson:** Inks and Coatings

## Student Learning Objectives.

Instruction in this lesson should result in students achieving the following objectives:

1. **Analyze inks and coatings.**
2. **Match inks and coatings to compatible substrates.**

## Resources.

The following resources may be useful in teaching this lesson:


E-unit(s) corresponding to this lesson plan. CAERT, Inc. http://www.mycaert.com.

Hershey, Jean-Marie. "Ink-Substrate Interactions…," *packagePRINTING*. Accessed May 18, 2018. http://www.packageprinting.com/article/the-wide-range-inks-substrates-used-package-printing-makes-ink-substrate-compatability-more-challenge-411596/all/.

Savastano, David. "Vehicles and Varnishes," *Ink World*. Accessed May 18, 2018. http://www.inkworldmagazine.com/issues/2013-07/view_features/vehicles-and-varnishes/.

"Sigma Pad Printing Inks," *PRINTEX*. Accessed May 18, 2018. http://printexusa.com/pad-printing-ink/.

Stephens, Bill. "Choosing the Right Ink: How to Make Sure Your Printing Stays Printed," *SignIndustry.com*. Accessed May 18, 2018. http://www.signindustry.com/screen/articles/2003-03-31-BS-ScreenInksPt1.php3.

"Substrate/Fabric," *UnionInk*. Accessed May 18, 2018. http://www.unionink.com/screenprinting-inks/substrate-fabric/.

"Substrates Used for Packaging," *Koenig & Bauer AG*. Accessed May 18, 2018. http://www2.kba.com/fileadmin/user_upload/KBA_Report/r33_beilage_en.pdf.


"Tips on How to Print on Different Substrates," *Hewlett-Packard Development Company, L.P.* Accessed May 18, 2018. https://h20435.www2.hp.com/hpg/attachments/hpg/HPLatex200Series/27/1/Tips%20on%20how%20to%20print%20on%20different%20substrates%20L250_L260.pdf.

## Equipment, Tools, Supplies, and Facilities

- ✓ Overhead or PowerPoint projector
- ✓ Visual(s) from accompanying master(s)
- ✓ Copies of sample test, lab sheet(s), and/or other items designed for duplication
- ✓ Materials listed on duplicated items
- ✓ Computers with printers and Internet access
- ✓ Classroom resource and reference materials

## Key Terms.

The following terms are presented in this lesson (shown in bold italics):

- affinity
- aqueous
- calendering
- cellophane
- coating
- color
- dye
- flexography
- gloss finish
- gravure inks
- heat setting
- hue
- ink
- ink opacity
- laminate
- matte finish
- overprinting
- paper varnish
- pigment
- polypropylene
- porosity
- printability
- printing ink
- saturation (chroma)
- substrate
- surface energy
- synthetic substrates
- tack
- value
- vehicle
- viscosity

## Interest Approach.

Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

> *To create an excellent end product for a manufacturer and for a user, the graphic designer or printer must assemble an excellent substrate-ink-coating combination. An excellent combination has good adhesion, appropriate scuff-, weather-, and moisture-resistance, light-fastness, color-fastness, and printability. A less than perfect combination can produce exactly the opposite results. Display end-product examples of substrate-ink-coating combinations. Then, have students search for examples of good substrate-ink-coating combinations. Lead a discussion on possible combinations of inks, coatings, and substrates for the products the students assembled.*

# CONTENT SUMMARY AND TEACHING STRATEGIES

**Objective 1:** Analyze inks and coatings.

**Anticipated Problem:** What is ink? What is printing ink? What are the properties of inks? What are coatings? What are the properties of coatings?

I. INK: ***Ink*** is a colored fluid or paste used for the printing, writing, and illustrating of images, graphics, or texts that are produced using pigments or dyes. Thick pastes are most commonly used in commercial printing. Inks are complex solutions that may be a combination of different substances. Solvents, pigments, dyes, resins, lubricants, solubilizers, surfactants, and fluorescence are just a few of these substances. Ink formulas typically contain two components: colorants (dyes and pigments) and vehicles (binders.) Both pigments and dyes are concentrated base colors because they absorb wavelengths of light. To understand inks and coatings, basic principles of color, viscosity, porosity, and coating characteristics must be observed.

A. COLOR: ***Color*** is the perception of light wavelengths that the human eye receives and processes from a reflected source. A color is a visual byproduct of the light spectrum, whether reflected or absorbed, and consists of three main parts: hue, value, and saturation.

B. PIGMENT: A ***pigment*** is an organic or inorganic, concentrated substance, whose opaque particles provide color when mixed with oil, water, or another substance (to create ink). Pigments change the color of reflected or transmitted light as the result of wavelength-selective absorption. Ink pigments add gloss, color, texture, and other characteristics to printed images. Pigments are insoluble, with no ***affinity*** (degree of attraction or ability to bind) to the substrate. The source or type of pigment affects print and color levels of hue, saturation (the intensity of the hue from brightness to lightness), and lightness.

C. HUE: A ***hue*** is the dominant wavelength (the most visible color seen), such as yellow, red, blue, or green. The three primary hues in light are red, green, and blue. [NOTE: The hue is the first characteristic we use to describe a color's value and saturation.]

D. VALUE: A ***value*** is the lightness or darkness of a color—the quantity of light reflected. For example, a pigment with dark values is a "shade" (a color that is darker than the original hue) and a pigment with light values is a "tint" (a color that is lighter than the original hue). Generally, adding black or more pigment to a color creates a shade. Adding white or a clear additive to a color creates a tint.

E. SATURATION: ***Saturation (chroma)*** is a measure of the brilliance, purity, and intensity of a color. For example, a pigment hue that is "toned" has both black and white added to the color to reduce saturation. Saturation is usually defined in

a range from 100 percent (pure color) to 0 percent (gray). In CAD, selecting 50 percent of a color gives you half the saturation of the pure tone.

F. DYE: A ***dye*** is a colored substance with an affinity to the substrate to which it is being applied (it will bond or combine with the substrate). Dyes are typically applied in an ***aqueous*** (water-based) solution.
   1. Due to their high affinity to bond, dye-based inks are stronger than pigment-based inks, and they can produce much more color of a given density per unit of mass.
   2. Most inks fall into four categories:
      a. Aqueous
      b. Liquid
      c. Paste
      d. Powder

H. INK PROPERTIES: Ink generally has three physical properties.
   1. *Optical:* Optical properties include pigment and color matching (the precise duplication of another color). Due to today's technological sophistication, color matching can be conducted wavelength by wavelength.
      a. ***Ink opacity*** is a measure of an ink's opaqueness or transparency, its degree of light transmission, and the visibility of background (or previously printed) colorings.
      b. Ink permanence and wettability are also optical considerations.
   2. *Structural:* The ability of ink to form long stringy filaments is an important structural property for consideration by designers and printers. Inks that are "long" have increased flow characteristics and form long threads of ink when pulled. Inks that are "short" flow poorly and have a buttery texture. Ink that is too long or too short is an undesirable ink.
      a. The ink's body is its consistency (hardness or softness). Ink for newsprint is soft and fluid. Ink viscosity is its ability to flow, or its resistance to flow.
      b. ***Tack*** is the ink's stickiness or adhesive quality. It is also the force required to disconnect the ink film (on the substrate) from the plate (or blanket) used for printing. [NOTE: If the tack exceeds the paper's surface strength, tearing can occur.]
   3. *Drying:* Drying is the process of removing the vehicle (liquid) from the pigment, or, in other words, the way the pigment hardens and becomes solid on the substrate's surface. The way the ink dries is important to prevent ink strike through, ink setoff, and ink chalking. Inks have several drying processes.
      a. Oxidation
      b. Absorption
      c. Polymerization
      d. Evaporation
      e. Precipitation
      f. Any combination of the above

I. PRINTING INK: ***Printing ink*** is an ink mixture specifically designed for press plates and conventional printer tasks. It consists of pigments of the required color mixed with oil, varnish, or another solvent. For example, black ink has usually been made from carbon blacks and thick linseed oil (or some similar oil, often with resin oil and rosin varnish added).

1. The key properties of a printing ink are its abilities to dry quickly and create good adhesion (grip) with the substrate surface. Both properties are subject to the absorbency of the substrate's surface and the choice of ink. Printing ink flows smoothly, and it holds enough color to create a readable image.
2. There are two basic types of printing ink: liquid (fluid and watery) and paste (thick and tacky).

J. PRINTING INK SUBSTANCES: Three main substances are involved in pigment-based printing inks.

1. *Vehicle:* A ***vehicle*** is the fluid part of the ink that transports the pigment to the substrate. Inks whose vehicles use a combination of drying methods include quick-set inks (solvent and a resin-oil mixture), cold-set inks (a resin-wax vehicle), water-soluble gum vehicles (such as watercolor inks), and photo-reactive vehicles (such as radioactive or UV).
2. Pigment: The colorant added to the vehicle.
3. Additives: Additives can be added to speed drying times or add body to the inks.
   a. Driers speed drying time.
   b. Bodying agents increase the ink's viscosity.
   c. Waxes prevent printing defects, such as ink setoff, blocking, and scuffing.
   d. Teflon is used to "shorten" the ink.
   e. Lubricants and greases prevent tackiness.
   f. Reducing oils and solvents, such as a thinner, increases the setting capacity of the ink.
   g. Antioxidants and anti-skinning agents keep ink from oxidizing and setting while on the press.
   h. Cornstarch adds body and reduces ink setoff.
   i. Surface-active agents enhance the dispersion of pigments in the vehicle.

K. OVERPRINTING: ***Overprinting*** is the process of printing one color on top of another in reprographics (reproduction processes). It is often used to make a print darker, or with more contrast. By printing dark or black ink over another dark ink, a rich black color is created. It is also used to add a graphic, stamp, or additional matter over a surface that has already been printed. In some cases, the paper or substrate is run through the printer or printing press more than one time to achieve this effect.

L. COATING: A ***coating*** is a protective covering or laminate applied by a printer or a finisher to a substrate through pigmentation, dipping, casting, brushing, air-knife applications, rolling, blading, and extruding. Coatings are applied for decorative and/or functional purposes, and they can be overall coatings or partial coatings.

Functionally, coatings can change the surface properties of the substrate and modify its qualities, including adhesiveness (ability to bond or grip), wettability, corrosion-resistance, or wear-resistance. Aesthetically, paper can be coated by a compound or polymer to add other characteristics to the paper, such as weight, surface gloss, smoothness, or reduced ink absorbency. Liquids, varnishes, and photo-reactive coatings are all popular coating options.

1. *Liquid:* Liquid coatings can be applied in-line (during printing) or off-line (after printing is completed). They include varnishes, aqueous, and UV varieties.
2. *Varnish:* ***Paper varnish*** is a coating that gives paper a smooth and consistent texture. It also seals the print to protect it. Varnishes are commonly used on good quality magazines covers, pamphlets, and brochures. Varnish coatings can be applied as spot coats to specific parts of the print job, such as a picture, or flooded across the entire sheet. Varnishes are available in gloss, satin, or matte finishes and with or without tints.
    a. A ***matte finish*** is a surface feature that raises the contrast of graphics and photos without creating a noticeable glare.
    b. A ***gloss finish*** is a surface feature that creates a smooth high-quality shine. Varnishes provide limited protection, are low cost, flexible, and easy to apply and also tend to yellow over time. A caution with varnish coatings is the release of harmful VOCs (volatile organic compounds); however, when dry, they are odorless and inert.
3. *Aqueous:* Aqueous coatings are low-cost, water-based coverings that provide protection from fingerprints and other blemishes. They can be applied in-line. They are shiny and smooth, have high abrasion and rub resistance, and are less likely to yellow over time (than varnish coatings). Aqueous coatings also dry faster than varnishes, so the turnaround time is shortened. Aqueous coatings are available in gloss or dull finishes, help prevent metallic inks from tarnishing, and can usually be overprinted on a laser printer. These should be used cautiously, since aqueous coatings tend to produce chemical burns upon skin contact.
4. *UV:* UV (ultraviolet) coatings have an extra high gloss, and they can offer more protection than other coatings. They can be applied in-line or off-line. UV coatings are liquid, and they are applied using a roller, screen, or blanket. Upon UV exposure, the coating hardens (with zero emissions). They may be applied across the entire sheet or to precise spots. UV coatings are available in high gloss, matte, satin, and specialty finishes (such as glitter, tints, and scents). These coatings can also produce chemical burns, and they tend to show fingerprints.
5. LAMINATE: A ***laminate*** is a protective coating (usually a plastic) applied to a printed surface to increase the strength, sturdiness, and water resistance of the surface. Laminates are available in a range of glossy and matte finishes and are applied off-line. They are either applied as a film or a liquid. Laminates create a durable surface that protects the end product from scratching, discoloration, and water. It is also possible to wash and clean laminated printed

material. They last longer than other print coatings. Four common laminate coatings are film, polyester, polypropylene, and nylon.

a. *Film:* Film laminates cost more than other types but offer more durability and resistance. Film works best on thick substrates and is typically high gloss.
b. *Polyester:* Polyester laminates provide the best resistance to heat and chemicals and are ideal for prints intended to last a long time. It is available in gloss, satin, or dull finishes.
c. *Polypropylene:* ***Polypropylene*** is a tough, flexible, synthetic, thermoplastic resin that is a polymer of propylene. It is used for laminates and other plastic products. Polypropylene is softer and easier to apply than film, and as a result, it is useful for folded products. It is available in gloss, satin, or dull finishes.
d. *Nylon:* Nylon is the most expensive laminate, and it is semi-permeable. It can be applied to one side of a sheet without causing the sheet to curl. It is ideal for a book cover.

**Teaching Strategy:** *Use VM–A to illustrate color wavelengths. Use VM–B to illustrate color pigments. Use VM–C to illustrate saturation. Use VM–D to illustrate laminators and large-scale printers. Consider inviting a graphic designer or printer to present various end products they have produced and the inks, varnishes, and laminates they used for each product. Ask the presenter to describe the method they used to select the ink and coating for these jobs.*

## Objective 2: Match inks and coatings to compatible substrates.

**Anticipated Problem:** What is a substrate? What is porosity? What is viscosity? How are inks and coatings matched to appropriate substrates?

II. In graphic communication, a ***substrate*** is the base material on which an image is printed (or coated). Substrates are used for the printing of graphic documents and communication vehicles (posters, flags, awnings, window coverings, outdoor furniture, bus advertisements, car wraps, billboards, etc.). A graphic artist's central task is matching the best substrate with the desired print job. Common graphic communication substrates include:

1. Bond papers
2. Conventional papers and parchment (including acid-free, adhesive-coated, coated, uncoated, cover, ledger, newsprint, offset, paperboard, or cardboard)
3. Handmade papers
4. ID and security papers
5. Metals
6. Plastic films or foils (from flexible to inflexible sheets or rolls)
7. Textiles

8. Vinyl (from flexible to inflexible sheets or rolls)
9. UV inks and coatings (liquid added on printed sheet images, only visible under ultraviolet or black light)
10. Wood

A. POROSITY: Substrate compatibility with the ink or coating is primarily based on the porosity of the substrate's surface condition (coated, uncoated, etc.). ***Porosity*** is a measure of the permeability that exists in a sheet. The porosity of paper substrates is measured by the passage of gas and liquids (air or inks) through the sheet. Paper is a highly porous material, and air can make up to 70 percent of its structure. The porosity rating of a substrate is an indicator of its ability to accept or absorb inks and varnishes.

1. The Gurley densometer (porosity tester) measures the seconds required for a given volume of air to pass through a single sheet of paper. It is generally used to measure porous papers. A high reading indicates a less porous (more dense) paper. A typical Gurley porosity test for a 50 pound, smooth offset would be 10 to 20 seconds.
2. The Sheffield porosimeter measures the flow rate of air through a single sheet. It is generally used on non-porous (very dense) paper sheets. A high rating indicates a more-open paper. Sheffield readings of a 60 pound, coated paper would be 10 to 20 units of air flow. Higher ratings mean that the substrate is able to absorb inks and varnishes, which increases its printability.
3. Surface sizing, coating, calendering, and supercalendering finishes work to seal or compress surface fibers, thus reducing the paper's porosity. The size and number of pores (holes, openings) are an important factor. These finishes can be used to create several categories of substrate surfaces:
   a. Uncoated, smooth papers
   b. Coated papers
   c. Gloss-coated papers
   d. Matte-coated papers
   e. Cardboard
   f. Synthetics
   g. Non-absorbent substrates

C. PRINTABILITY: ***Printability*** is the ease with which a substrate can be printed on—based on uniform ink adhesion and an acceptable visual quality. ***Viscosity*** is the thickness, stickiness, and flowing resistance of a fluid. Viscosity measures the ease of moving through a fluid. A liquid with low viscosity is said to be thin, whereas a substance with a high viscosity is said to be thick. Generally, printing inks have a glutinous (sticky) consistency. Printers select the most appropriate ink based on adhesion (grip or bonding). With the use of different vehicles (additives that affect thickness, drying time, and saturation), inks are formulated with viscosities and drying properties that correspond with each paper type.

D. UNCOATED PAPER: Thinner, less viscous inks that dry by absorption are used on highly absorbent uncoated papers, such as newsprint. Uncoated paper has a wide range of specific absorbencies and surface structures. For example, inks for

printing on uncoated papers are typically of average viscosity (like a paste ink) that dry through oxidation and absorption. However, uncoated papers may be calendered or supercalendered to create a smoother, less porous surface finish.

1. ***Calendering*** is a finishing process in which the substrate is passed under rollers at high temperatures and pressures to smooth, dry, or coat, surfaces. This process is used on cloth, paper, or plastic film to make the substrate smooth and glossy.
2. Supercalendering is the additional calendering process to a paper after it has been finished (and calendered). These papers tend to react like coated papers, and require inks with a higher viscosity.

E. COATED PAPER: Coated papers generally have a smooth finish, and they don't absorb ink as well as uncoated papers. Many coatings are water repellent and glossy. These papers require inks that dry quickly by oxidation. Some inks used with coated papers are heat set. ***Heat setting*** is a process used to affix plastic, paper, and fabric coatings in a permanent fashion through thermal means (heating). Some coated papers are compatible with high-gloss inks that provide high resolution, high quality images.

F. SYNTHETICS: ***Synthetic substrates*** (man-made or chemically-altered papers, films, and plastics) include vinyl, polycarbonate, polyester, polypropylene, and polyethylene. Synthetics are measured for ink and coating compatibility by their surface energy. ***Surface energy*** is the molecular reaction (energy of bonding) to the surface tension (gravitational force) of a liquid. In this case, it is the relationship or interaction between the liquid (ink, varnish, etc.) and the solid surface of the substrate. These energies are measured in dynes per centimeter. Ink-to-substrate surface tension and energy ratings allow the printer to determine compatibility. When printing on synthetics, the surface energy of the substrate must be higher than the surface tension of the ink. Synthetics and non-absorbent substrates (such as vinyl or plastic) have specific requirements.

1. These substrates work best with non-absorbing inks containing a quickly evaporating solvent. Water-based inks may also be used, but only in flexography.
2. ***Gravure inks*** are fluid toners with a very low viscosity that allows them to be drawn into the engraved cells of a cylinder and transferred onto the substrate. These inks are comprised of a pigment, a binder, and a solvent. The binder uniformly disperses the pigment and binds it to the substrate surface. The solvent dissolves the binder, and then it evaporates during the drying phase.
3. ***Flexography*** (flexo or aniline printing) is a printing process that uses soft, flexible relief plates that easily transfer ink onto a substrate. It is the major process used to print packaging materials, such as corrugated containers, gift wraps, folding cartons, multi-wall paper sacks, plastic bags, milk and beverage cartons, disposable cups and containers, food and candy wrappers, labels, envelopes, newspapers, and paperback books. Substrates best suited for flexography include paperboard, plastic, metal films, cellophane, kraft paper, and corrugated paper. Flexography uses inks with low viscosity and evaporative drying. The printing presses can use water-based inks on non-absorbent substrates, such as laminated surfaces, paperboard, or polyolefins.

a. The presses can also print on surfaces such as cellophane. ***Cellophane*** is a thin, flexible, transparent material made from wood pulp or cotton cellulose fibers. It is mostly used as a moisture-proof wrapping.
b. Non-synthetic papers that need to be cut, folded, and bundled in quick succession are also typically printed with flexographic processes. This includes kraft paper for packaging.

**Teaching Strategy:** *Use VM–E to illustrate porosity of printed packages of silica gel desiccant. Use VM–F to illustrate offset press ink viscosity. Assign LS–A.*

**Review/Summary.** Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. Questions at the ends of chapters in the textbook may also be used in the Review/Summary.

**Application.** Use the included visual master(s) and lab sheet(s) to apply the information presented in the lesson.

**Evaluation.** Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as student performance on the application activities. A sample written test is provided.

## Answers to Sample Test:

### Part One: Matching

1. b
2. g
3. e
4. a
5. f
6. h
7. c
8. d
9. I

### Part Two: Completion

1. saturation
2. hue
3. aqueous
4. vehicle
5. matte

6. surface condition
7. paper
8. absorption
9. calendering
10. surface energy

## Part Three: Short Answer

Answers may vary, but should include some or part of the following:

1. Substrate compatibility with the ink or coating is primarily based on the porosity of the substrate's surface condition (coated, uncoated, etc.). ***Porosity*** is a measure of the permeability that exists in a sheet. The porosity of paper substrates is measured by the passage of gas and liquids (air or inks) through the sheet. Paper is a highly porous material, and air can make up to 70 percent of its structure. The porosity rating of a substrate is an indicator of its ability to accept or absorb inks and varnishes.

   The Gurley densometer (porosity tester) measures the seconds required for a given volume of air to pass through a single sheet of paper. It is generally used to measure porous papers. A high reading indicates a less porous (more dense) paper. A typical Gurley porosity test for a 50 pound, smooth offset would be 10 to 20 seconds.

   The Sheffield porosimeter measures the flow rate of air through a single sheet. It is generally used on non-porous (very dense) paper sheets. A high rating indicates a more-open paper. Sheffield readings of a 60 pound, coated paper would be 10 to 20 units of air flow. Higher ratings mean that the substrate is able to absorb inks and varnishes, which increases its printability.
2. ***Viscosity*** is the thickness, stickiness, and flowing resistance of a fluid. Viscosity measures the ease of moving through a fluid. A liquid with low viscosity is said to be thin, whereas a substance with a high viscosity is said to be thick. Generally, printing inks have a glutinous (sticky) consistency. Generally, printing inks have a glutinous (sticky) consistency, but they can be liquid (fluid and watery). With the use of different vehicles (additives that affect thickness, drying time, and saturation), inks are formulated with viscosities and drying properties that correspond with each paper type.

**Sample Test**

Name _____

# Inks and Coatings

## Part One: Matching

***Instructions:*** **Match the term with the correct definition.**

a. coating
b. color
c. laminate
d. pigment
e. printability
f. printing ink
g. substrate
h. paper varnish
i. tack

_____1. The perception of light wavelengths that the human eye receives and processes from a reflected source

_____2. The base material on which an image is printed (or coated)

_____3. The ease with which a substrate can be printed on—based on uniform ink adhesion and an acceptable visual quality

_____4. A protective covering or laminate applied by a printer or a finisher to a substrate through pigmentation, dipping, casting, brushing, applying via air-knife, rolling, blading, and extruding

_____5. An ink mixture specifically designed for press plates and conventional printer tasks

_____6. A coating that gives paper a smooth and consistent texture

_____7. A protective coating (usually a plastic) applied to a printed surface to increase the strength, sturdiness, and water resistance of the surface

_____8. An organic or inorganic, concentrated substance, whose opaque particles provide color when mixed with oil, water, or another substance (to create ink)

_____9. The ink's stickiness or adhesive quality

## Part Two: Completion

***Instructions:*** **Provide the word or words to complete the following statements.**

1. The measure of the brilliance and intensity of a color is _____.
2. The dominant wavelength (the most visible color seen), such as yellow, red, blue, or green is a/an _____.
3. An ink in which the solvent is water-based is a/an _____ ink.
4. The fluid part of the ink that transports the pigment to the substrate is the _____.
5. A surface feature that raises the contrast of graphics and photos without creating a noticeable glare is a/an _____ finish.
6. Substrate compatibility with the ink or coating is primarily based on the porosity of the substrate's _____.
7. A highly porous material that is made up of as much as 70 percent air is _____.
8. Inks for printing on uncoated papers are typically of average viscosity (like an ink paste) that dry through oxidation and _____.
9. A finishing process in which the substrate is passed under rollers at high temperatures and pressures to smooth, dry, or coat surfaces is _____.
10. Synthetics are measured for ink and coating compatibility by their _____.

## Part Three: Short Answer

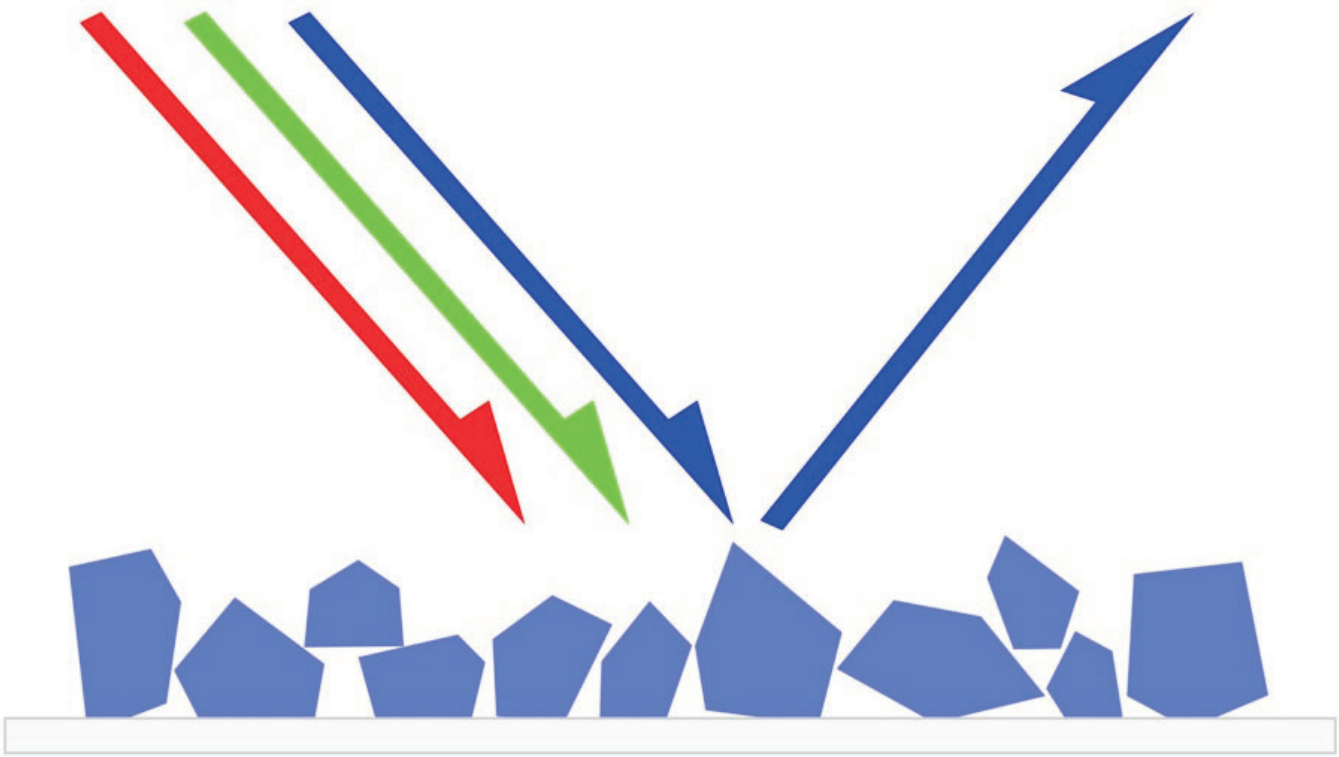
***Instructions:*** **Answer the following.**

1. Describe substrate compatibility with an ink or coating based on porosity. Include a description of one of the two tests used to determine porosity levels.

2. Describe viscosity and the general viscosity of printing ink.

# COLOR WAVELENGTHS: ABSORPTION AND REFLECTION

**Color** is the perception of light wavelengths that the human eye receives and processes from a reflected source. A color is a visual byproduct of the light spectrum, whether reflected or absorbed, and consists of three main parts: hue, value, and saturation.



# PIGMENTS

A **pigment** is an organic or inorganic, concentrated substance, whose opaque particles provide color when mixed with oil, water, or another substance (to create ink). Pigments change the color of reflected or transmitted light as the result of wavelength-selective absorption. Ink pigments add gloss, color, texture, and other characteristics to printed images.

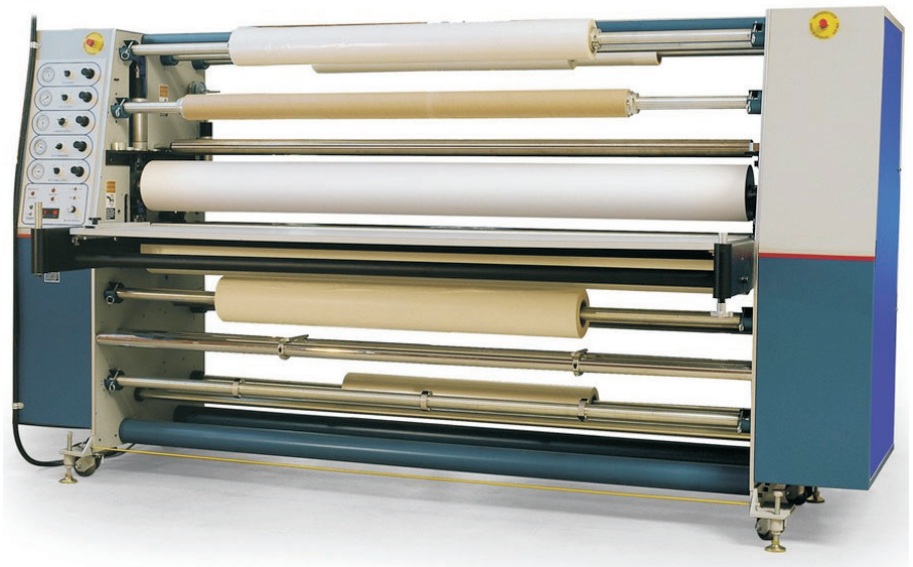
*(Courtesy, Dan Brady) (https://creativecommons.org/licenses/by/2.0/deed.en)*

# SATURATED COLOR

***Saturation (chroma)*** is a measure of the brilliance, purity, and intensity of a color. For example, a pigment hue that is "toned" has both black and white added to the color to reduce saturation. Saturation is usually defined in a range from 100% (pure color) to 0% (gray). In CAD, selecting 50% of a color gives you half the saturation of the pure tone.

# LARGE SCALE LAMINATORS

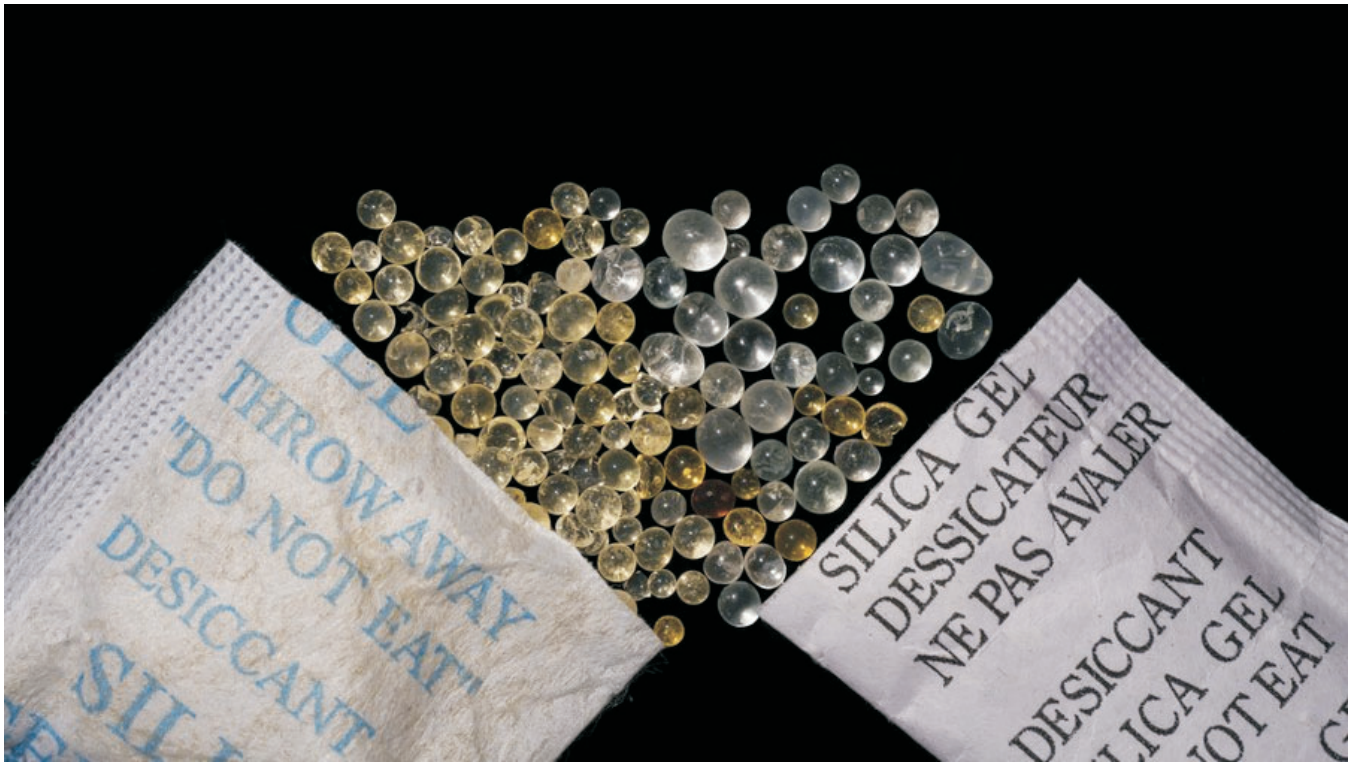
A **laminate** is a protective coating (usually a plastic) applied to a printed surface to increase the strength, sturdiness, and water resistance of the surface. Laminates are available in a range of glossy and matte finishes and are applied off-line. They are either applied as a film or a liquid. Laminates create a durable surface that protects the end product from scratching, discoloration, and water.



VM–E

# POROSITY

Substrate compatibility with the ink or coating is primarily based on the porosity of the substrate's surface condition (coated, uncoated, etc.). **Porosity** is a measure of the permeability that exists in a sheet. The porosity of paper substrates is measured by the passage of gas and liquids (air or inks) through the sheet. Based on this definition, what porosity level [Scale of "1 (low) to 4 (high)"] would you rate the packaging for these silica desiccant gels? Are both packages equally porous?



# VISCOSITY

**Viscosity** is the thickness, stickiness, and flowing resistance of a fluid. Viscosity measures the ease of moving through a fluid. A liquid with low viscosity is said to be thin, whereas a substance with a high viscosity is said to be thick. Based on this definition, do the inks in these offset press pots appear to have a thin or a thick viscosity?

LS–A

Name _____

# Select Substrates, Inks, and Coatings for Three Graphics Jobs

## Purpose

The purpose of this lab activity is to research and select appropriate substrates, inks, and coatings for three graphic communication jobs.

## Objective

1. Research, select, and match substrates, inks, and coatings for specific graphics jobs.

## Materials

- lab sheet
- class notes and/or E-Unit
- device with Internet access and printer
- pen or pencil

## Procedure

1. Review your class notes about inks and coatings.
2. The following three print jobs come into your workplace. Your task is to assign a substrate to each job. Then, match inks and/or coatings for each project. Complete the Project Table by researching and selecting the best substrates, inks, and coatings for the projects. The "Rationale" column should list the reasoning behind each choice.

## Project Table

| Project | Substrate, Ink, &/or Coatings | Rationale |
|---|---|---|
| Business card for a local business | *Substrate:*<br><br>*Ink & Coating:* | |
| Bumper sticker for a local radio/TV station | *Substrate:*<br><br>*Ink & Coating:* | |
| Sports schedule for a school/local/university/ professional team | *Substrate:*<br><br>*Ink & Coating:* | |

3. Present your selections and rationale to the class. [OPTIONAL: Present your selections and rationale to the business, radio/TV station, or sports team.]
4. Participate in a discussion of everyone's selections, and the rationale of their choices.
5. Turn in your complete lab sheet to your instructor.