TECHNICAL BULLETIN

COTTON INCORPORATED

6399 Weston Parkway, Cary, North Carolina, 27513 • Telephone (919) 678-2220

ISP 1008

BINDERS FOR TEXTILE APPLICATIONS

This bulletin is sponsored by the Importer Support Program and written to address the technical needs of product sourcers.

TABLE OF CONTENTS

SUMMARY

The use of pigment binders is very important in producing pigment colored fabrics in the textile industry. The fastness that can be obtained is, in many cases, adequate for the majority of end use specifications. The resulting hand or feel of the item being colored in this manner is important and is, by the nature of the process, going to be slightly harsher than the un-colored fabric. With proper selection of binder and the application system and variables, it is possible to produce an acceptable compromise in this regard. While hand is vital, it is not the only criteria used in selecting a binder. Durability, measured through color retention, is also important. Some of the softest binders have limited ability to hold the pigment onto the fabric so a binder system that can satisfy performance requirements on many levels is generally desired.

INTRODUCTION

In a 2002 Cotton Incorporated Technical Report *TCR02-22*[1], it was estimated that the total amount of printed cloth would exceed 28.4 billion square meters per year. Around 53 percent of that cloth is printed with pigments. Pigments offer great flexibility in processing, as they require no after-treatment other than drying and curing. This ease of handling also accounts for increases in pigment usage for solid shade dyeing and garment dyeing of textile substrates.

Textile pigments are defined as colored organic substances, which do not solubilize in water or other solvents easily and require a binding agent to hold them on the textile fiber. Pigments have no affinity to cotton and no mechanism to bond with this fiber. Organic pigments can be dispersed with a surfactant in water and this dispersion is then blended with a water-soluble or a water based emulsion of a polymerizable resin. The water is removed by drying and the polymerization is produced by heat. Therefore, when a pigment is applied to a fabric it is done so in conjunction with a binder[2]. The binder selected must perform several functions in order to produce a low cost, colored, desirable, and sellable textile. "Pigment Dyeing" of 100% cotton is a misnomer in that the cotton fiber is only a base on which this pigment colored resin matrix is adhered.

History of Binders

Before modern pigment preparations, the textile printer used such colorants as colored metal oxides, naturally occurring organic pigments, and other colored substances to impart color to fabrics. These were held on the fabric with protein binders such as casein and egg albumin. In the mid 1930’s, pigmented lacquer systems based on ethyl cellulose and even nitrocellulose were being printed on fabrics. The fabrics were very stiff and the crocking or rubbing off of color was poor. Plasticizers such as urea formaldehyde and alkyd resins improved the crocking and handle of the fabric, but this was still inferior to printing with dyestuff[3].

In the mid to late 1930’s, Interchemical Corporation (BASF) developed the water in oil emulsion allowing for a discontinuous film application, which led to a soft smooth hand, however, crocking was still a problem. World War II saw the invention of synthetic rubber latex and butylated melamine formaldehyde resins. These two polymeric compounds were incorporated into the water in oil emulsion (oil phase) and crock and wash fastness were significantly improved. This system became very popular for producing quality prints. However, the oil phase solvents and the clean up on the print machine required the use of more solvents and created problems with effluent and working conditions.

In order to solve this problem with oil phase systems, water based systems were needed. The first water based print systems were oil in water emulsions or water phase systems. This meant that the water was now the continuous phase and the color and binder would be deposited as a continuous film.

The thickener and surfactant used in roller printing these systems worked well enough to impart good running properties and fabric hand. The same system in screen-printing, however, tended to clog screens and produce a very stiff fabric. Screen-printing pastes were reformulated to use synthetic thickeners based on neutralized polyacrylic acids. These print pastes were then applied with high levels of mineral spirit solvents to achieve a discontinuous film and thus a soft fabric handle. Pigments were reformulated to be non-ionic dispersions containing little or no resin. Finally, the binders required for these systems evolved into increasingly branched chain versions of various carboxylated polymers. The systems incorporated softeners to further plasticize the film and produce softer prints with good fastness.

Presently, the systems employed for pigment printing are solvent free and are capable of running in rotary screen-printing with very good color yield and adequate fastness.

Water In Oil Emulsion 1930's – 1970's	Oil In Water Semi-emulsion 1940's – 1980's	Modern Rotary Screen Print All Aqueous 1980's – Present Day
Pigment	Pigment	Pigment
Mineral Spirits	Binder	Synthetic Thickener
Turpentine	Thickener Concentrate	Binder System
Oleophylic Surfactant	Water	Cross Linking Agent
Clear Concentrate	Mineral Spirits	Softener
ABS Latex	Lubricant	Water
Water		

<u>Binder Requirements</u>

Textile binders are necessary to form a matrix to entrap the pigment particle and must be stable to outside forces that would tend to dislodge the pigment from the textile substrate, such as washing or rubbing. A binder must lend itself to application and have other characteristics to enhance the coloring effect of the pigment. Since pigment coloration is an additive effect to the substrate, the components of this addition will tend to change the feel of the substrate or fabric.

Binder traits:

- Inexpensive
- Provide good color yield
- Non toxic
- Soft

- Wash fast
- Provide good crockfastness
- Easily polymerized
- No stain and build up on equipment
- Non-yellowing
- Not affect lightfastness
- Be stable in application

Binder Basics

The process where a molecule of a chemical will react with other identical molecules and in the process form larger chainlike molecules called polymers is known as polymerization. The individual molecules are called monomers. Acrylic acids such as methacrylic acid and methyl methacrylic acid, are two examples of simple acrylic monomers that can be polymerized to resins with a high molecular weight, which will in turn, form films around the pigments and will adhere to the substrate thus binding the pigment.

The most common binder in use today is the acrylic monomer. These products are easily polymerized by the removal of water, through evaporation, and the addition of heat. In most cases the binder will completely polymerize once the water is removed by drying and after one to two weeks at ambient conditions. This type of polymerization produces a linear polymer that literally entangles the pigment and itself in the fabric/fiber matrix. The relative fastness properties of these simple polymers is, as one might suspect, not as good as a binder that requires more energy to complete the process.

While this does accomplish the basic function of the binder, this type of polymer may be more susceptible to removal by rubbing or washing than a binder that would also incorporate more association with the fibers. For instance, if the binder contained additional sections of polymer known as “branched chains” or “arms”, it could latch onto other segments of polymer at right angles to the long linear chains. This three dimensional nature would be more stable to outside forces such as rubbing and washing. But by nature, once the system becomes three-dimensional it becomes more rigid and thus would make the fabric stiffen. These polymer-forming additions are referred to as “copolymers”.

As a general statement, most commercial binders are already mixtures of several copolymers, which in turn enhance the properties of the particular binder being used. In some cases, a textile pigment binder system is composed of pigment and binder only. In many more cases, the binder system is a more or less complex mixture of pigment, binder, auxiliary chemicals, auxiliary binders, and cross-linking agents. All of these systems are referred to as “Binder Systems”.

BINDER DELIVERY SYSTEMS

1. Textile Printing – Print System
2. Pigment Padding – Padding System
3. Pigment Garment Dyeing – Exhaust Dyeing System

Since each one of these systems describes the process of application, each will be looked at with the application or delivery system in mind. The constraints and special requirements of the binder in each case must be noted.

1. Print System

The print system is applied by conventional textile printing via rotary screen-printing, engraved roller printing, or flat bed screen-printing. The print paste contains the pigment, binder system, thickener system, and water. The print paste for each color in the pattern (usually 1 – 12 colors) is applied in order of *pitch* on the fabric as the fabric is passed through the machine. The fabric is then passed through a drying phase (usually a hot air oven) and then collected by folding flat or winding up on a rolling device. The fabric is then sent through a second hot air oven to cure the binder system and bring about polymerization of the resin. The binder curing step is often combined with the drying step or it can be combined with a post cure procedure.

After drying and curing, the fabric is ready for finishing, which may include a durable press resin, softeners, water repellants, and hand and color modifiers. In some cases, the resin finish is applied prior to printing. Since finishing also requires curing, the binder cure step can be combined with the finish cure step for cost and performance efficiency.

The printing system application is composed of four segments:

- Thickener Preparation
- Color Preparation
- Printing
- Drying

Textile printing is primarily done on rotary screen-printing machines. There is still some engraved roller printing and flatbed screen-printing being performed, but the majority (95-98%) is by the rotary screen process. The quality of this process is very much dependent on proper thickener usage.

The thickener system is present to impart a viscosity to the paste such that it does not penetrate the screen until forced through by the squeegee or bar used in the printing motion. Once the bar passes over the print paste, it is expected to return to its original viscosity[2].

The actual printing is performed using a water-soluble thickener to which the binder system is added along with the pigments themselves. This mixture is called the print paste. The first step in this process is the thickener preparation. The stock thickener is prepared in bulk and is made up in a tank with a high shear barrel type of mixer. The formulation calls for water to be added to the tank after which the mixer is turned on and ammonium hydroxide is then added. This insures that the pH is adjusted to an alkaline condition so that the thickener concentrate will properly disperse and hydrate the water to achieve the desired thickening.

Stock Thickener

- Water
- Ammonium Hydroxide

- Synthetic Thickener Concentrate

The binder is charged with adding hand to the fabric, but the increase in hand is not only a function of the binder, it is a combination of the thickener used to make the print paste, together with the binder. The thickener is bound to the fabric with the pigment and binder. It is important to look at both the thickener and the binder and their combined effect on hand.

The second step in preparation of the printing paste is the addition of the binder system and its components to the stock thickening. The components of this portion of the stock thickening are:

Binder System
- Binder
- Crosslinker
- Softener

In many cases, the print system is more efficiently compounded if the binder is added to the water before the thickener concentrate is added. This would be the preferred method. Crosslinking agents and softeners are added after thickening the system. Other auxiliaries, if needed, are also added after thickening has occurred.

Auxiliaries used in printing are:
- Crosslinking agent, which is a resin, usually a melamine compound, that links by chemical reaction the binder polymer to itself to increase its durability and enhance fastness. These products, while improving wet fastness, can also increase hand.
- Softener compounds, usually emulsified oils or silicone, are products that increase the flexible nature of the binder even after crosslinking so that the finished film is "softer". These products may also have a detrimental effect on fastness when used in excess.
- Antiwicking compounds are products that increase the solids content of the print paste and help prevent the wicking or flushing that accompanies printing on fabrics containing resin and catalyst. By nature, these products can increase the hand of the binder if used improperly, but do not normally affect fastness.
- Emulsifiers or surfactants are in addition to the surfactants present in both pigments and binders and are intended to assist in printing and running properties. These compounds are also used to achieve smoother and cleaner prints, but can interfere with binder fastness.

The last step in compounding the color for printing is the formulation of the print paste. Since the stock paste contains both thickener and binder systems, only the pigment colorant needs to be added. The binder concentration in the stock thickener is usually adequate for most pigment formulations, however, there may be instances when additional binder must be added. One example would be when printing a black motif with black pigments, which always requires additional binder for fastness. Another scenario would be when the formula calls for a pigment concentration that is higher than the amount of binder in the stock paste can accommodate.

Print Paste
- Pigment
- Stock Thickener

- Water or Additional Thickener
- Additional Binder (If needed)

The pigment to binder ratio used is recommended by the various binder and pigment manufacturers. These recommendations are based on a 1: 1.5-2.0 ratio of pigment to binder. This ratio is based on the theoretical dry weight of both pigment and binder. Pigment concentrations vary from 5% to 35% pigment. Binder emulsions are 20% to 40% active ingredients. The manufacturers factor these considerations into their recommendations.

In actual practice, the printing process may vary substantially, but in essence the following is a normal process for the application of textile pigments by the printing process.

The typical flow for a pigment print procedure is as follows:

Cloth Supply (Open Width)	Entry Frame
Cloth Onto Print Blanket Through Print Machine Screens Print Pattern Onto Cloth Separate Cloth From Print Blanket	Print Machine
Enter Print Drying Oven On Mesh Conveyer	Drying Oven
Exit Drying Oven And Separate From Mesh Conveyer	Exit Oven

There are no further requirements. No steaming, aging, washing, or any further finishing steps are necessary to complete the pigment coloration process. However, in many cases, the last wet processing step is application of the fabric finish to the printed and dried-cured fabric. Resin finishing, mechanical softening, calendaring, or Sanforizing™ may be required to finish the fabric in a satisfactory way.

Since a large percentage of the woven fabrics and almost all of the knitted fabrics of both cotton and cotton blends are going into apparel, the additional "Hand" imparted by pigment print may, in many cases, be disagreeable. The desire to improve the "Hand" is the driving force in many pigment print improvements made to date.

2. Padding System

A padding device, usually a two-roll padder in front of a pin-tenter frame, applies the pigment padding system. In some cases, the padder is set up in front of a series of steam heated dry cans, which do not provide any width or heat control. The pigment padding system contains the pigment, the binder system, and an anti-migration system in water. After passing through the pad trough, the fabric is squeezed by the pad rollers to remove the excess solution and the fabric is guided onto the pin clips on the tenter frame. The tenter frame oven or dry cans accomplishes both the drying and the curing function. After exiting the oven, the fabric is batched on a roll-up device.

The addition of resin finishing chemicals to the pigment padding system allows for coloration and finishing of the fabric in one step. This procedure requires compatibility of the components for successful application.

Pigment padding can be broken up into several steps for simplification similar to the printing system description. The padding system application is composed of three stages:

- Pad Bath Preparation
- Padding
- Dry / Cure

Pad Bath Preparation

Several considerations must be made when selecting a binder for a pad application:

- The binder must be rewettable. Poor rewetting characteristics promote premature polymerization. Premature polymerization on equipment, or binder build up on pads and dry cans leads to contamination of the shade and poor quality. This rewettability is usually improved with increasing surfactant levels, which may lead to foaming.
- The binder should have a tolerance to pH fluctuations to minimize flocculation in the dye bath. The pH of the dye bath must be maintained at 7.0 or higher until the fabric has been padded.
- The binder needs to be compatible with other auxiliaries such as anti-migrants, wetting agents, resins, and resin catalysts.
- Finally, resin and catalyst can affect the emulsion of the binder system, and the order of addition is very important in the bath make-up.

The pH of the pad bath is a critical factor in the performance of the binder and in the even and successful application of the shade. Since this is the case, ammonium hydroxide is added as the first ingredient to the water before any other chemical. This insures a pH in the alkaline range for the finished bath. The order of addition of the various ingredients is also crucial to good operation and success. The pigment dispersions are stabilized at a pH of 7.5-8.5 and are stable in this range or even in acid conditions if handled with care. The binder, however, is stable in the 7.5-9.5 range, but will begin to polymerize if the pH of the bath becomes acidic. When this happens, the pigment will be flocculated out of the bath and the bath cannot be used for padding. This fact is the key when combining a resin with a pigment pad bath.

Primary Pigment Padding Formulation*	**Pigment Padding Formulation with Resin***
• Water	• Water
• Ammonium Hydroxide	• Ammonium Hydroxide
• Binder	• Binder
• Anti-migrant	• Anti-migrant
• Pigment	• Resin
	• Softener
	• Pigment
	• Catalyst**

*The formulations are stated in order of addition **The catalyst should be added just before padding.

Padding
The padding device, usually a two-roll padder in front of a pin-tenter frame, applies the pigment system. The pad volume should be no greater than 12-15 gallons (45-60 liters). This insures a rapid turnover of pad liquor, which prevents tailing of the shade that can occur because of the nature of the relatively large particle size of the pigment colorants. One of the characteristics of pigment padding is that foam is invariably produced, and fitting the pad trough with a foam "Guard" device will reduce poor quality due to this phenomenon. The foam produced will be stabilized by the binder and will create poor quality unless a provision for foam management is employed.

Drying
As in the case of the printing process flow, the padding flow proceeds from pad to the dryer.

The typical flow for a pigment pad procedure is as follows:

Cloth Supply (Open Width)	Entry Frame
Cloth Is Passed Through Pad Bath Padded Cloth Is Squeezed In Pad Rollers – 70-80% Wet Pick-Up	Padder
Padded Fabric Proceeds Into The Tenter Chains Padded Fabric Is Pressed On Chain Pin Clips	Frame Entry
Padded Fabric Enters Drying Oven On Tenter Chains	Drying Oven
Exit Drying Oven And Separate Chain Clips	Exit Oven

Where the application system consists of only a pad and drying cans, the system padded would always be the pigment bath without resin. Since drying and curing of both the binder and the resin takes place in the frame oven, heat controls are essential for producing the desired results. The temperature is gradually increased to 340-350ºF (170-175ºC) whether or not resin is included in the bath. This insures that the cloth will first dry and then reach a cloth temperature necessary for good curing. In some cases, a cool down set of cans are employed to reduce the fabric temperature before batching the fabric in roll form. The pad bath is slightly alkaline at the time it is padded. Since the resin would require an acid pH for proper curing, the ammonium hydroxide is volatilized during the curing step and the catalyst, which is non-volatile, becomes the controlling pH contributor and an acid pH is available for curing.

3. Exhaust Dyeing System

Exhaust dyeing of textile pigments is commonly seen in garment dyeing and is performed using modified commercial laundry machines. The exhaust system application is composed of four stages:

- Fabric Cationization
- Pigment Exhaustion

- Binder Exhaustion
- Drying

Fabric Cationization

The fabric or garment to be dyed is loaded into a commercial washing machine and after wetting the fabric, the cationic agent is added to the bath and exhausted onto the fabric. The fabric is impregnated with a cationic agent to give the slightly anionic pigment dispersion an affinity to the fabric. This process is known as cationization.

Cationizing Step

- Cationic Imparting Agent
- Wetter
- Acetic Acid, 56% for pH control

The cationic agent is applied with a wetting agent and acetic acid onto the fabric in the batch or commercial dyeing machine. After a period of time, the fabric is rinsed and the machine is set to exhaust the pigment solution.

Pigment Exhaustion

Dyeing Step

- Pigment colorants
- Dispersing agent
- Water

The pigments are first mixed with water and a dispersing agent that imparts an anionic charge to the pigments. This solution is added gradually to the dyeing machine. The temperature of the bath is slowly increased and the machine is held at the dyeing temperature for up to 20 minutes. The fabric is held at an elevated temperature to increase the adsorption of the pigments. At this point, the heat is turned off and the binder solution is added.

Binder Exhaustion

Binder Application Step

- Acrylic Binder
- Water

At this point, the binder is fed into the dyeing machine and exhausted onto the fabric over a period of time. Acetic acid is added to the bath, which facilitates binder polymerization, then the fabric is rinsed, the dyeing machine is drained, and the fabric is extracted.

Drying

After extraction, the fabric is moved to a dryer; in the case of garments, this is a commercial tumble dryer. Drying continues the binder curing process.

The typical flow for a pigment garment dye procedure is as follows:

Garments Loaded Into Machine	Dyeing Machine
Cationization	
Pigment Exhaustion	
Binder Exhaustion	
Extraction	
Tumble Drying	Tumble Dryer

An alternative method of binder application is to exhaust the binder right after the cationic agent is applied. Then the fabric is rinsed and the machine is set for the addition of the pigment. This method does tend to produce more uniform appearance, but fastness is decreased.

BINDER PROPERTIES

There are a variety of different binders available to the textile processor. And there are many end use requirements that a particular binder has to fulfill. A list of binders, in their generic form, has been compiled, along with ratings as to their performance to crocking, washing, dry cleaning, and light. This has been constructed to provide an overview of different binders and their properties at a glance.

BINDER PROPERTIES

Binder Chemistry	Hand	Application	Fastness Crock – Light			Fastness Cleaning		Weakness	Use
	Soft – Firm	Print – Pad – Exhaust	Dry Crock	Wet Crock	Light	Dry Clean	5HLTD		
Acrylic	Soft	All	Fair	Poor	Good	Fair	Poor	Fastness	Common
Butadiene Acrylonitrile Acrylic Latex	Firm	Print	Best	Good	Good	Good	Good	Hand	Special
Acrylic Butadiene Acrylonitrile + Melamine	Firm	Print	Good	Fair	Good[1]	Fair	Fair	Hand	Common
Carboxylated Butadiene-Acrylonitrile	Soft	Print	Good	Fair	Good[1]	Good	Fair	Wet Fastness	Special
Acrylic + Styrene Acrylate	Firm	Print	Fair	Poor	Good	Good	Fair	Abrasion	Special
Acrylic + Butadiene Acrylonitrile + Melamine	Medium	Print	Good	Good	Good[1]	Good	Best	Light fastness in pale shades	Common
Acrylic+ Melamine	Medium	Print & Pad	Good	Fair	Good	Good	Good	Wet crock	Common
Acrylic + Melamine + Softener	Medium	Print & Pad	Good	Fair	Good	Fair	Good	Crock & DC[2]	Common
Acrylic + Cross Linker + Softener + Emulsifier	Soft	All	Fair	Poor	Good	Poor	Poor	Fastness	Common
Vinyl Acrylate	Firm	Print	Fair	Fair	Good	Fair	Fair	Hand	Special

1. Light fastness in very pale shades may be affected by this binder. When tested without color, a noticeable shade change was observed.
2. DC = dry cleaning

Fabric Constructions

Substrate constructions will affect the application of the pigment in all of the application modes. The overall effect is germane to the particular fabric construction and is not necessarily a result of the binder or other ingredients in the system. Woven and non-woven substrates seem to exhibit more innate stiffness while knitted fabrics and yarn applications produce more flexible and thus softer end products. Fastness with the same application on a series of different fabrics tends to perform equally across the board. The classifications of substrates are as follows:

1. Woven
2. Knit
3. Nonwoven
4. Yarn
5. Other Substrates (Plastic films and netting are two examples)

Troubleshooting

At some point or other the process, whether it is printing, padding, or garment dyeing, does not go as smoothly as planned. This table contains a listing of the most commonly experienced challenges along with some recommendations for rectifying the situation.

TROUBLESHOOTING

Topic	Printing	Padding	Exhaust Dyeing
Poor Dry Crock	Increase Binder Reduce Pigment Do Not Re-cure	Increase Binder	Increase Binder
Poor Wet Crock	Re-cure Add Cross Linker Reduce Pigment	Cross Linker	Re-wash
Poor Abrasion	Add Softener	Add Softener	Add Softener
Poor Wash Fastness	Cross Linker	Cross Linker	Increase Binder
Fabric Cracking	Add Softener	Add Softener	Re-wash
Clogged Print Screens	Add Emulsifier & Ammonia	N/A	N/A
Poor Color Yield	Viscosity pH Fabric	Anti-migrant	Increase Pigment % OWF[1]
Yellowing of Fabric	pH Change Binder	pH of Fabric	N/A
Poor Light fastness	Pigment Selection	Pigment	Pigment
Poor Dry Clean Fastness	Usually Pigment Selection	Pigment	Pigment
Poor Appearance	Thickener Fabric	Anti-migrant Drying	Dyeing Procedure
Pigment Build Up on Cans	N/A	Binder Rewettability	N/A
Binder Kicking Out of Bath	N/A	pH Compatibility	pH Compatibility

1. OWF = on weight of fabric

Glossary:

Abrasion	The resulting friction of fabric-to-fabric rubbing which in turn causes a noticeable loss of color and a poor appearance.
Binder	Resin polymer emulsion for binding pigment on fabric.
Cationization	Imparting a positive charge to the fabric with a chemical agent to enhance the attraction of colorants and chemicals.
Crockfastness	The color transferred from the surface of a colored textile to another surface by rubbing is known as crockfastness. The ideal would be that no color was transferred in this process. Poor crockfastness is the case when much color is transferred in this manner.
Dispersion	A two phase system where one phase consists of finely divided particles distributed through another substance, such as a solid dispersed in a liquid (i.e. pigments and disperse dyes).
Dry Clean Fastness	The color lost or the color change observed in commercial dry cleaning with solvent is fastness to dry cleaning. The greater this change, the worse the fastness.
Emulsion	Non water-soluble liquids can be incorporated in water by the process of finely dividing the liquids into small droplets and stabilizing this division with chemicals called emulsifiers. The liquid is emulsified in the water and the product is called an emulsion.
Fabric Cracking	It is noticeable sometimes when heavy coverage printed fabric are subjected to handling. This condition is due to the stiffness of the film made up of binder and print paste. The binder may need to be replaced with a softer more flexible product or it may be possible to add an auxiliary softener to the print paste.
Flocculation	The combination or aggregation of suspended solid particles in such a way that they form small clumps.
Lightfastness	Lightfastness is the color change observed after a colored textile is exposed to a controlled light source to simulate and accelerate the effect of sunlight and its components on the textile. Binders have some effect on lightfastness, but the primary source of color change is associated with the colorant itself.

Glossary: (Continued)

pH The actual definition is the inverse of the hydronium ion concentration of a solution. It is a measure of the acidity or alkalinity of a water based system. A pH of 7.0 is neutral and anything higher than 7.0 is alkaline and any reading lower than 7.0 is acidic.

Pitch Pitch refers to the order or sequence the color screens in a pattern are printed. This order is based on various factors (eg. colorant, machine, and pattern).

Polymerization The chemical combination of individual molecules called monomers with other monomers of the same structure to form a higher molecular weight substance known as a polymer is polymerization. This process is the method for formation of the binder film to hold pigments on the substrate.

Rewettable Rewettability is the property of a dried binder film that allows it to redisperse into water. This property is important in padding and printing processes. When the machine stops and is restarted, the drying that occurred during the stop is easily rewet with the minimum effect on quality.

Sanforizing™ This term refers to the patented process using steam controlled tension and mechanical compaction to preshrink cotton fabrics mechanically before shipping to the consumer.

Washfastness This is the observation of the color change and appearance difference of a colored textile after exposure to a washing procedure. Conditions of the test are designed to indicate how the fabric will perform in actual use with the consumer.

References

1. Cotton Incorporated Textile Research and Implementation Report TCR02-22
2. Imperon® Pigment Dyes: Printing: Fletcher Stone – Hoechst Celanese Corporation Presented at the COTTECH Conference – 1991
3. Pigment Printing Handbook, A History of Pigment Printing: Frank Sheldon Published by AATCC Committee RA - 80 Printing Technology

Major Manufactures of Textile Pigment Binders

4. ABCO Industries, Inc.
   200 Railroad Street
   Roebuck, SC 29376
   (864) 576-6821

5. BASF Corporation
   Performance Chemicals
   4330 Chesapeake Drive
   Charlotte, NC 28216
   (800) 556-6742

6. Bayer, Corporation
   100 Bayer Road, Building 14
   Pittsburgh, PA 15205-9741
   (800) 662-2927

7. CIBA Specialty Chemicals Corporation
   Consumer Care
   P.O. Box 2444
   High Point, NC 27261-2444
   (336) 801-2741

8. DyStar L. P.
   9844-A Southern Pine Blvd.
   Charlotte, NC 28273
   (800) 439-7827

9. Glo-Tex International, Inc.
   25 Stan Perkins Road
   Spartanburg, SC 29307
   (864) 579-9897

10. Noveon, Inc.
    9911 Brecksville Road
    Cleveland, OH 44141-3247
    (800) 380-5397

11. Organic Pigments Corporation
    Division of Synalloy Corporation
    P.O. Box 2667
    Greensboro, NC 27402-2667
    (336) 373-8361

12. Pioneer Chemical, Inc.
    101 Goldsmith Street,
    P.O. Box 576
    Greenville, SC 29602
    (864) 232-4304

13. Reichhold, Inc.
    P.O. Box 13582
    Research Triangle Park, NC 27709-3582
    (919) 990-7500

14. Rohm & Haas Company
    8901 Research Drive
    Charlotte, NC 28262
    (704) 717-1300

Importer Support Program

The Cotton Board and Cotton Incorporated are funded by U.S. upland cotton growers and importers of cotton and cotton products (this includes raw cotton, piece goods, and finished apparel). A percentage of the importer funds are devoted for importer specific programs organized under the Importer Support Program. Examples of projects funded from this fund include training schools, educational programs, focus groups, economic meetings, and research initiatives.

Selected technical issues have been identified by importer members as relevant to their business. This report is a condensed, less technical report of those issues intended to provide the reader with basic, yet useful information on the topic.

For more information contact:

ELIZABETH KING
VICE PRESIDENT
IMPORTER SERVICES
COTTON BOARD
PHONE: 973-378-7951
FAX: 973-378-7956
eking@cottonboard.org

DENNIS P. HORSTMAN
SENIOR DIRECTOR
ACCOUNT MANAGEMENT
COTTON INCORPORATED
PHONE: 919-678-2336
FAX: 919-678-2231
dhorstman@cottoninc.com

Visit our website at: www.cottoninc.com

COTTON INCORPORATED