

TECHNICAL BULLETIN



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CHEMICAL FINISHING COTTON AND NATURAL BLEND[®] FABRICS

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INTRODUCTION

Generally, finishes are applied to cotton and NATURAL BLEND® fabrics to impart a desirable hand, for shrinkage control, to improve sewability, or to impart other performance features. Fabric construction, processing methods, and the types of preparation, dyeing, and finishing equipment used will also significantly influence final performance properties. This technical bulletin is intended to provide guidelines for the chemical finishing of cotton and cotton containing fabrics.

PREPARATION FOR FINISHING

The methods and equipment used in the preparation and dyeing of cotton containing fabrics vary greatly. Before fabrics are submitted for finishing, they should be clean and uniformly absorbent, with a pH between 5.5 and 7.0, and a total alkalinity not exceeding 0.05% alkalinity as sodium hydroxide. Proper preparation is essential for optimum finishing results.

FINISHING COMPONENTS

Crosslinkers

With more stringent industry standards, formaldehyde control is becoming increasingly important in the selection of crosslinkers. The use of methylated or glycolated DMDHEU* considerably reduces free formaldehyde levels on fabrics. Non-formaldehyde durable press agents currently available include butane tetracarboxylic acid and the reaction product of dimethylurea and glyoxal.

The amount of crosslinker used should be determined on an individual basis. The determination should be made by evaluating the effect of the proposed finish on the properties required for the fabric end use, including strength, durable press, shrinkage control, shade and hand.

The reaction product of dimethylurea and glyoxal has several advantages. It is non-formaldehyde and gives a good balance of durable press, strength, and abrasion resistance. Blending dimethylurea/glyoxal with DMDHEU can give an improved durable press over using dimethylurea/glyoxal alone, while at the same time maintaining good strength and abrasion resistance. The tradeoff is that you do not have a formaldehyde-free system.

Some of the formulations listed in this bulletin show a range of concentrations for individual products. This range represents trials we have made to evaluate different levels of performance and to evaluate strength retention on various fabrics. It is recommended that recipients of this information also evaluate each formulation in the same manner to arrive at the best balance of desired properties.

*Dimethyloldihydroxyethylene urea

Note: NATURAL BLEND® is a registered trademark of Cotton Incorporated for blended products containing a minimum of 60% Upland Cotton which have approved performance characteristics.

Catalysts

Under some conditions, the catalyst type and catalyst concentration may adversely affect the shade and/or lightfastness of certain dyes. Some reactive dyes have been found to be particularly susceptible to color change with certain catalysts. The effect of the finish on dye properties should be evaluated on laboratory samples before conducting plant trials. Magnesium chloride has been found to perform with a minimal effect on most shades. The catalyst may also influence the printability of some resin treated fabrics.

Hand Modifiers

If a silky, resilient finish is desired, a silicone emulsion polymer system is a good choice. The newest class of silicone polymer softeners, the aminofunctional silicones, not only impart a desirable hand to cotton fabrics, but can also improve durable press appearance without the use of conventional crosslinking resins. However, the durable press rating will not be as high as can be achieved with conventional crosslinking resins. Abrasion resistance is also improved after treatment with an aminofunctional silicone. Discoloration may be a problem with whites and pastel shades, and should be evaluated on an individual basis.

Other suitable softeners include polyethylenes and fatty acid derivatives. Blends of softeners are frequently used.

To impart crispness or body to a fabric, an acrylic polymer or a polyvinyl acetate may be used. These polymers also tend to improve shrinkage control. Hand modifiers should be selected with care to avoid problems with pad bath stability, pad roll buildup, mark-off, and crocking.

Surfactants

A nonionic surfactant as a wetting agent is usually recommended.

Other Additives

Where extra measures are required to maintain shrinkage control, a melamine resin, in combination with an acrylic resin, has been found to be particularly effective. However, excess free formaldehyde may be a problem with melamine resin. The hand may also be adversely affected.

Selected acrylic soil release and fluorochemical finishing products have been found to be compatible with the finishes outlined in this bulletin.

FORMULATIONS

The wet pickup in these examples may vary from 55 to 75%, depending on the fabric, type pad rolls, and pad pressure.

For Excellent Smoothness and Resilience

	<u>% On Weight of Bath</u>
Surfactant (nonionic)	0.1 - 0.2
Silicone Softener ^(a) (30%)	0.5 - 3.0
Polyethylene Softener ^(b) (30%)	0.5 - 3.0
DMDHEU Resin (45%)	5.0 - 15.0
Catalyst	1.5 - 3.8

- (a) Silicone softeners can be selected to give a wide variety of hand properties. Some of these silicone softeners require other additives for durability.
- (b) Polyethylene softener is useful as a sewing lubricant, to improve the abrasion resistance, and as an extender for the more expensive silicone softeners.

Note: Figures in parentheses represent percent solids or percent activity.

Other Softeners

A variety of other softeners are available to achieve different hand and processing effects. These softeners include fatty acid derivatives (esters, amides, ethoxy compounds, and quaternary cationic species).

Non-Formaldehyde Durable Press Formulations

	<u>% On Weight of Bath</u>
Surfactant	0.1 - 0.2
Softener (30%)	2.0 - 3.0
Dimethylurea/glyoxal (45%)	10.0 - 20.0
Catalyst	2.5 - 4.0

	<u>% On Weight of Bath</u>
Surfactant	0.1 - 0.2
Softener	2.0 - 3.0
Butane tetracarboxylic acid	5.0 - 10.0
Sodium hydrophosphite ^(c)	3.3 - 6.5

- (c) This catalyst may adversely affect some dyes. For dyed fabrics, sodium dihydrogenphosphate may be used. However, this catalyst may produce lower durable press properties than the sodium hydrophosphite.

**Blending Dimethylurea/Glyoxal and DMDHEU for
Improved Durable Press with Good Physical Properties**

	<u>% On Weight of Bath</u>
Surfactant	0.1
Softener	3.0
Dimethylurea/glyoxal (45%)	16.0
DMDHEU (45%)	4.0
Catalyst	4.0

NOTE: This formulation has given good performances in the laboratory. Before commercial production is planned, a complete in-plant evaluation is recommended to evaluate shelf life and related fabric/finish properties.

**For Improved Surface Appearance and Superior Hand
When Shrinkage Control Is Achieved by Mechanical Means**

	<u>% On Weight of Bath</u>
Surfactant	0.1 - 0.2
Reactive silicone (30%)*	1.0 - 5.0

*Some reactive silicones require other auxiliaries to achieve durability.

**Formulations Applied in Cotton Incorporated's Dyeing and
Finishing Research Laboratory to Fabric Development Samples***

Cotton Soft 200 Finish (% OWB)

0.3% Nonionic surfactant
2.0% Amino functional cationic silicone
3.0% Nonionic high density polyethylene

Cotton Soft 200 Plus Finish (%OWB)

Same as Cotton Soft 200 with added crosslinker
5.0 - 15.0% DMDHEU
1.5 - 3.8% Magnesium chloride catalyst

***Note:** These formulations and resulting fabric features have received complimentary responses from the industry.

Cotton Soft 100 Finish (%OWB)

0.3% Nonionic surfactant
2.0% Modified reactive silicone emulsion
3.0% Nonionic high density polyethylene

Cotton Soft 100 Plus Finish (%OWB)

Same as Cotton Soft 100 with added crosslinker

5.0 - 15.0% DMDHEU

1.5 - 3.8% Magnesium chloride catalyst

DRY/CURE CONDITIONS

The fabric is usually dried and cured in one pass down the tenter frame. The curing temperature is usually 350 - 390°F (177 – 199°C). with the time depending on the resin, the fabric weight, and efficiency of heat transfer. The mechanical handling of the fabric will depend on the construction (knit or woven) and the equipment available.

CHEMICAL SOURCES

<u>SUPPLIER</u>	<u>TRADE NAME</u>	<u>CHEMICAL NATURE</u>
DMDHEU BASED CROSSLINKER		
Omnova Solutions Inc. 1476 JA Cochran By-Pass Chester, SC 29706	PERMAFRESH [®] ULF	Modified Reactant
Bayer Corporation 103 Harrison Bridge Rd. Simpsonville, SC 29681	PROTOREZ [®] 6041B	Modified Reactant
CATALYST		
Omnova Solutions Inc. 1476 JA Cochran By-Pass Chester, SC 29706	CATALYST [®] KR	Magnesium Salt
	CATALYST [®] 531	Modified Magnesium Salt
SILICONE EMULSION POLYMER SYSTEMS		
High Point Chemical Corporation P.O. Box 2316 High Point, NC 27261	SIL-FIN [®] WHP	Amino Functional Silicone
SOFTENERS		
High Point Textile Auxiliaries P.O. Box 2316 High Point, NC 27261	SIL-FIN [®] WHP	Amino Functional Silicone
Omnova Solutions Inc. 1476 JA Cochran By-Pass Chester, SC 29706	MYKON [®] HD SEQUA SOFT [®] 69	High Density Polyethylene Silicone Emulsion
SURFACTANTS (Nonionic)		
Union Carbide Corporation Old Ridgebury Road Danbury, CT 06817-0001	TERGITOL [®] TMN-6	Trimethyl Nonanol Ethoxylate
Omnova Solutions Inc. 1476 JA Cochran By-Pass Chester, SC 29706	SULFANOLE [®] 634	Nonionic Biodegradable Wetting Agent
MELAMINE RESIN		
Noveon Incorporated 8309 Wilkinson Blvd. Charlotte, NC 28237	AEROTEX [®] RESIN MW AEROTEX [®] RESIN M-3	Melamine Formaldehyde Melamine Formaldehyde

NON-FORMALDEHYDE DURABLE PRESS AGENTS*

<u>SUPPLIER</u>	<u>TRADE NAME</u>	<u>CHEMICAL NATURE</u>
BASF Corporation Textile Chemical Group P.O. Box 668846 Charlotte, NC 28266	FIXAPRET® NF	Dimethylurea/Glyoxal
Sequa Chemicals, Inc. One Sequa Drive Chester, SC 29706	PERMAFRESH® SILVER	Dimethylurea/Glyoxal
Bayer Corporation 103 Harrison Bridge Rd. Simpsonville, SC 29681	PROTOREZ® 6036	Dimethylurea/Glyoxal

*When these reactants are used, the catalyst and curing conditions recommended by the manufacturer should apply.

The chemicals listed above are those used by Cotton Incorporated. Products from other suppliers may also be satisfactory.

The statements, recommendations and suggestions contained herein are based on experiments and information believed to be reliable only with regard to the products and/or processes involved at the time. No guarantee is made of their accuracy, however, and the information is given without warranty as to its accuracy or reproducibility either express or implied, and does not authorize use of the information for purposes of advertisement or product endorsement or certification. Likewise, no statement contained herein shall be construed as a permission or recommendation for the use of any information, product or process that may infringe any existing patents. The use of trade names does not constitute endorsement of any product mentioned, nor is permission granted to use the name Cotton Incorporated or any of its trademarks in conjunction with the products involved.

RESEARCH AND TECHNICAL SERVICES

Cotton Incorporated is a research and promotion company representing cotton worldwide. Through research and technical services, our company has the capability to develop, evaluate, and then commercialize the latest technology to benefit cotton.

- Agricultural research leads to improved agronomic practices, pest control, and fiber variants with properties required by the most modern textile processes and consumer preferences. Ginning development provides efficient and effective machines for preservation of fiber characteristics. Cottonseed value is enhanced with biotechnology research to improve nutritional qualities and expand the animal food market.
- Research in fiber quality leads to improved fiber testing methodology and seasonal fiber analyses to bring better value both to growers and then mill customers.
- Computerized fiber management techniques result from in-depth fiber processing research.
- Product Development and Implementation operates programs leading to the commercialization of new finishes and improved energy and water conserving dyeing and finishing systems. New cotton fabrics are engineered -- wovens, circular knits, warp knits, and nonwovens -- that meet today's standards for performance.
- Technology Implementation provides comprehensive and customized professional assistance to the cotton industry and its customers -- textile mills and manufacturers.
- A fiber-to-yarn pilot spinning center allows full exploration of alternative methods of producing yarn for various products from cotton with specific fiber profiles.
- The Company operates its own dyeing and finishing laboratory, knitting laboratory, and a laboratory for physical testing of yarn, fabric, and fiber properties including High Volume Instrument testing capable of measuring micronaire, staple length, strength, uniformity, color, and trash content.

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