

Chapter 12

Finishes



Objectives

- ◊ What is a finish?
- ◊ What are the different types of finishes and how do they affect fabrics/end product?
- ◊ What processes do they go through and how does it affect the environment?



- **Finish:** Anything done to fiber, yarn, or fabric either before or after fabrication to change the appearance, hand, and performance of the fabric.

Finishing: An Overview

Finishing

- **Normal sequence (not all steps are finishes):**
 1. Fiber processing
 2. Yarn processing
 3. Fabrication preparation
 4. Fabrication
 5. Finishing preparation
 6. Whitening
 7. Coloration
 8. Finishing
 9. Rework
- **Finishing:** by converters or mills

Finishing

- ◊ **Preparatory**
- ◊ **Aesthetic**
- ◊ **Functional**
- ◊ Finish life
 - ◊ **Permanent:** for life of product
 - ◊ **Durable:** for life of product, diminishes with time
 - ◊ **Temporary:** until conclusion of first cleaning cycle
 - ◊ **Renewable:** can be replaced

Finishes

- ◊ Finishes
 - ◊ Visible (can be seen)
 - ◊ Invisible (see effect)
- ◊ Processing:
 - ◊ Chemical or wet
 - ◊ Mechanical or dry

Fabric Terms

- ⊗ **Greige goods:** fabrics after fabrication, but before finishing
- ⊗ **Loom state:** yarn dyed fabrics after fabrication, but before finishing
- ⊗ **Converted or finished goods:** after finishing
- ⊗ **Mill-finished goods:** finished by mill

Developments in Finishing

- ⊗ **Foam finishing:** Foam carries finishing agent; less water; less energy to move & dry fabrics, quicker process; less uniform than water finishes.
- ⊗ **Solvent finishing:** Use solvent, less common.
- ⊗ **Computer control:** Less labor, high quality finished goods.
- ⊗ Combine steps to decrease costs and environmental impact; to improve quality.

Routine Finishing Steps

- ⊗ Described for all cotton or cotton/ polyester suiting weight – but similar for most fabrics.
- ⊗ **Fiber processing:** fibers processed separately
- ⊗ **Yarn processing:** fibers aligned, blended, twisted

Routine Finishing Steps

- ⊗ **Yarn preparation:**
 - ⊗ **Slashing:** Warp yarns coated with mixture of natural and synthetic resins (sizing, starch, gum, lubricant, or preservative) to increase abrasion resistance.
 - ⊗ **Fabrication:** fabric woven, knit, or other process

Fabric Preparation

- ⊗ **Handling:** Physical form (length and width) of fabric during finishing.
- ⊗ **Run:** Quantity of fabric receiving same processing at same time.
- ⊗ **Open width or tubular/rope form:** Continuous or batch process.
- ⊗ **Singeing:** Burn off fiber ends to minimize pilling and give smoother fabric surface.

Fabric Preparation

- ⊗ **Desizing:** Sizing on warp removed by physical agitation or chemical (enzyme or acid); process depends on fiber and sizing.
- ⊗ **Cleaning:** Warp sizing, dirt, oil, or other soil removed.

Fabric Preparation

- ◉ **Bio-polishing:** Use cellulose enzyme to remove surface fuzz.
- ◉ **Scouring:** More rigorous process than cleaning; removes soil and foreign matter (natural waxes and gums) before dyeing and special finishing.
 - Gum from silk (degumming)
 - Wax from cotton (kier boiling or boiling-off)
 - Lanolin from wool (scouring)

Routine Finishing: Wool

- ◉ **Crabbing:** “setting” of wool fabrics
- ◉ **Decating:** gives smooth, wrinkle-free finish to wool fabrics
- ◉ **Carbonizing:** removes plant matter, prepares for dyeing for more level or uniform color
- ◉ **Pressing:** steaming wool fabrics

Whitening

- ◉ **Bleaching:** Cleans and produces uniformly white goods.
- ◉ **Optical brighteners:** Fluorescent compounds mask yellow.



Preparation

- ◉ **Mercerization:** Sodium hydroxide improves dye affinity of cotton & HWM rayon (slack mercerization); increases strength, luster, & absorbency (tension mercerization).
- ◉ **Ammoniating finish:** Alternate for mercerization for cellulosic fabrics; lower cost; less polluting; less effective for dyeing, but fewer problems with durable press finishes.

Routine Finishing Steps

- ◉ **Coloration:** adding color (dyeing or printing)
- ◉ **Special purpose finishes:** i.e., wrinkle resistant, soil-release, and fabric-softening
- ◉ **Tentering:** Straightens and dries fabric; held between pins or clips, heated in oven; impact on fabric grain.



Routine Finishing Steps

- ◉ Drying
 - ◉ **Loop drying:** without tension for soft finish; for towels & knits
 - ◉ **Heat setting:** heated under tension to set resin finishes or thermoplastic fibers
 - ◉ **Calendering:** gives smooth, pressed finish to fabric
- ◉ Reworking
 - ◉ **Inspecting:** examining fabric to ensure specified level of quality
 - ◉ **Repairing:** flaws repaired when possible

Environmental Impact

- ⊗ Finishing systems control air pollution, prevent pollution, & dispose of hazardous waste.
- ⊗ Reduce use of water, chemicals, and energy.
 - ⊗ Minimize water use (foam & solvent finishing) or reclaim, recycle, & reuse water.
 - ⊗ Treat water to improve quality of discharge water.
 - ⊗ Chemicals less hazardous to health & environment
- ⊗ Minimize use of chemicals; finish fabric correctly the first time.

Aesthetic Finishes

- ⊗ Change appearance or hand; may change fabric name
- ⊗ Many possibilities from same greige goods
- ⊗ Permanence related to fiber content & technique
- ⊗ Process additive or subtractive

Equipment

- ⊗ **Padding machine:** Applies finishes and dyes.
- ⊗ **Backfilling machine:** Also applies finishes.



Luster

- ⊗ Changes light reflectance.
- ⊗ **Glazed:** Friction calender produces highly glazed surface; one cylinder rotates faster; resin or starch possible.
 - ⊗ Glazed chintz, polished cotton
- ⊗ **Ciré:** Similar to glazed, hot calender glazes surface; adds more luster.
 - ⊗ Ciré taffeta/satin



Luster

- ⊗ **Plasticize:** Thin polymer layer; higher glaze.
- ⊗ **Moiré:** Water-marked design on ribbed fabrics; two fabrics calendered or etched calender.
 - ⊗ Moiré taffeta/ottoman



Luster

- ⊗ **Schreiner:** Roller engraved with fine lines for deep luster; flattens yarn for smoother appearance and better cover.
 - ⊗ Satin, sateen, damask, tricot, etc.

Drape

- ◉ **Embossed:** Melt design on thermoplastic fabric surface (controlled surface glazing of yarns).
- ◉ **Crisp & transparent:**
 - ◉ **Parchmentize:** treat cellulose with acid (organdy)
- ◉ **Burned-out (deglaze):** Print chemical on fabric that dissolves one fiber.



Drape

- ◉ **Sizing:** Temporarily adds body and weight.
- ◉ **Weighting:** Metallic salt added for stiffness.
 - ◉ Weighted silk



Texture and Hand

- ◉ **Embossed:** Produces raised designs.
 - ◉ Embossed cotton



- ◉ **Pleated:** Variation of embossed.
- ◉ **Puckered surface:** Chemical printed on nylon or polyester shrinks fabric.

Texture and Hand

- ◉ **Plissé:** Print NaOH on cotton, shrinks, creates puckered effect; areas dye darker.

- ◉ Plissé



- ◉ **Flocked:** Add surface fiber with adhesive for localized pile effect.



Texture and Hand

- ◉ **Embroidered:** Stitch thread on fabric (eyelet embroidery); shuttle & multi-head; schiffli (older process being replaced by shuttle).

Eyelet



Shuttle: face (left), back (right)

Texture and Hand

- ◉ **Expanded foam:** Compound expands with heat, three dimensional.
- ◉ **Sheared:** Pile or nap cut to controlled height; patterned or not.

Texture and Hand

- ◉ **Brushed:** Fiber ends swept off fabric after shearing.
- ◉ **Napped:** Brush fibers to surface for fuzzy, soft hand; increased warmth & beauty; contributes to water & soil repellency.
 - ◉ Flannel, flannelette, fleece



Texture and Hand

- ◉ **Crepeing:** Special compacting process for hand, comfort stretch, and drape.
- ◉ **Fulled:** Controlled shrinkage (compacted) of wool fabrics; improved hand and appearance.



Texture and Hand



- ◉ **Beetled:** Mechanical flattening of yarns to make weave appear tighter.
 - ◉ Damask, crash
- ◉ **Coronized:** Heat setting, dyeing, and finishing glass fiber.
- ◉ **Emerized, sueded, or sanded:** Fabric abraded to create soft hand.
 - ◉ Peach skin look

Texture and Hand

- ◉ Abrasive, chemical, or enzyme wash
- ◉ **Chemical wash:** Chemical alters fiber surface.
- ◉ **Abrasive wash:** Chemically saturated abrasive material tumbled with fabric.
- ◉ **Enzyme wash:** Cellulase enzyme removes surface fuzz; decreases pilling & fabric weight.
- ◉ **Silk boil-off:** remove sericin to create looser, more mobile yarns in the fabric



Texture and Hand

- ◉ **Caustic (or alkali) treatment:** Dissolve portion of fiber for greater yarn mobility.
- ◉ **Hand builders:** Softens hand; silicone softeners & cellulase enzyme; better wrinkle resistance.
- ◉ **Tufted:** Add surface yarn for pile effect.



Special-Purpose Finishes

- ◉ Make the product better suited for specific end use
- ◉ Most do not alter appearance, but improve performance
- ◉ Adds cost
- ◉ May decrease other performance characteristics
- ◉ Usually topical or additive in nature
 - ◉ Wet processes; chemical finish

Stabilization/Shrinkage Control



- ⊗ **Shrinkage:** relax tension from spinning, fabrication, and finishing; consumer problem
- ⊗ **Relaxation:** occurs during first care cycle
- ⊗ **Progressive:** occurs in subsequent care cycle
- ⊗ Processes to remove relaxation shrinkage
 - ⊗ **Knits:** minimize stress by supporting fabric on blanket during finishing; heat set blends
 - ⊗ **Wovens:** mechanical process; fabric shrinks during processing

Stabilization/Shrinkage Control

⊗ Processes to remove progressive shrinkage

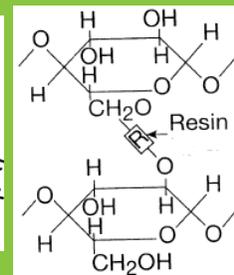
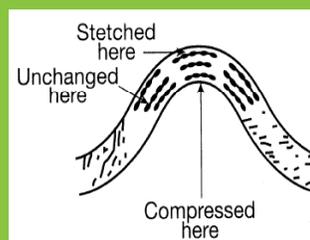
- ⊗ **Thermoplastic fibers:** heat set
- ⊗ **Wool:** halogenation dissolves part of scale; surface coat scale with film; environmental restrictions of chlorine compounds use of some applications
- ⊗ **Rayon:** use resins to prevent swelling and stretching

Shape Retention Finishes

- ⊗ **Wrinkle recovery theory:** Cross-links return molecules to original shape and prevent wrinkle retention; resins (formaldehyde or other based) create cross-links.
- ⊗ **Problems:** Stiff fabric; poor hand; yellowing; strength loss; offensive odors; color problems (frosting and migration); affinity for oily soils; static; lint; seams pucker; health problems.

Shape Retention Resin

Returns fibers to their original shape



Durable Press Processes

- ⊗ **Precured:** Saturated, cured (heat set), & sewn; retains flat shape, hems roll.
- ⊗ **Postcured:** Saturated, sewn, & cured; permanent creases; alterations difficult.
- ⊗ **Immersion:** Sew, dye, & finish product; immerse in cross-linking agent & additives to control hand & performance; dry; press; cure; fabric preparation critical; process control difficult; expensive.

Durable Press Processes

- ⊗ **Metered addition:** Sew, dye, and finish product; spray on controlled amount of cross-linking agent & additives control hand & performance; tumble until evenly coated; dry; press; cure; fabric preparation critical; process control difficult; expensive.
- ⊗ **Vapor phase:** Sew, dye, and finish product; additives control hand & performance; apply resin as vapor in closed chamber & cure in chamber; fabric preparation critical; process control less difficult; expensive.

Shape-Retention Finishes

- ◉ **Durable press wool:** Resin treatments.
- ◉ **Durable press silk:** Polycarboxylic acid effective; strength loss; stiffer; loss in whiteness.
- ◉ **Care:** Wash frequently; pretreat soiled areas; small loads; cool temperatures in laundering.



Appearance Retention Finishes

- ◉ **Soil and stain-resistant finishes:** minimize soil or maximize soil removal
 - ◉ Fluorochemicals or organic silicones
 - ◉ Oil-borne stains released or resist redeposition
 - ◉ Prevents soil from adhering and increases wettability
- ◉ **Carpet:** combine modified fiber, stain resistant finish, and compound blocks fiber dye sites



Appearance Retention Finishes

- ◉ **Abrasion resistant finishes:** Acrylic resin increases abrasion resistance; pocket linings, linings.
- ◉ **Antislip, slip-resistant, or nonslip finishes:** For low count, smooth surface, smooth filament yarn fabrics; resin binds yarns together reducing seam slippage and fraying.

Appearance Retention Finishes

- ◉ Fume-fading resistant, antifume, atmospheric fading protective finishes: minimize fume fading by preventing reaction between dye and fume.



Appearance Retention Finishes

- ◉ Surface or back coating
 - ◉ **Metallic coating:** on fabric back to minimize heat transfer through fabric
 - ◉ **Plastic coating:** minimize slippage, snagging; adds body; leather-like look; may be water proof
 - ◉ **Acrylic foam:** minimizes air flow through fabric; increases fabric thickness; finishes back
 - ◉ **Latex backcoating:** binder for tufted fabrics
 - ◉ **Problems:** poor age resistance; may separate, peel or flake; stiffens; becomes tacky

Appearance Retention Finishes

- ◉ **Light-stabilizing finishes:** Light stabilizers or ultraviolet absorbers added to minimize damage from light; important for some furnishings and industrial products.
- ◉ **Pilling resistant finishes:** Minimize pill formation; fabric exposed to ultraviolet light; immersed in oxidative solution; causes fiber ends to break off rather than forming pills.

Comfort-Related Finishes



- ◉ **Water repellent finishes:** resist wetting; combine finish with fabrication
- ◉ **Fluorocarbons:** improve water repellency; decreases with washings, but recovered with heat
- ◉ **Wax emulsions or metallic soaps:** renewable
- ◉ **Resins of surface active agents:** durable
- ◉ **Silicones:** most common type; durable if applied with durable press chemicals; good drape, soft hand, stain resistance
- ◉ Resistance to water-borne stains also imparted.

Comfort-Related Finishes

- ◉ **Porosity control (air impermeable) finishes:** Limit penetration of air.
- ◉ **Water absorbent finishes:** Increases moisture absorbency; surface coating of synthetic fiber fabrics; towels, diapers, underwear, active sportswear.

Comfort-Related Finishes

- ◉ **Ultraviolet absorbent (sun protective or ultraviolet (UV) blocker) finishes:** incorporate chemical compound that absorbs energy from UV light; improves sun protective factor of fabrics; may include dyes and fluorescent whitening agents
- ◉ Antistatic finishes
 - ◉ Improve surface conductivity, attract water, develop opposite charge or combination
 - ◉ Quaternary ammonium compounds (fabric softeners)

Comfort-Related Finishes

- ◉ **Fabric softeners:** Softens hand; may increase absorbency.
- ◉ **Phase change finishes:** Incorporate phase changing compounds (micro-encapsulated) that absorb or release heat during phase change (liquid to solid or vice versa); minimize heat flow through fabrics; may alter other performance characteristics.

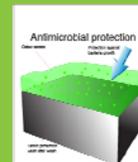


Biological Control Finishes

- ◉ **Insect & moth control finishes:** Repel insects by odor, poison, or unpalatable taste; wool furnishings.
 - ◉ Permethrin applied to tents/canvas for outdoor living application.
- ◉ **Mold & mildew control finishes:** Use chemicals to prevent mold/mildew growth.
- ◉ **Rot proof finishes:** Protection from rotting for outdoor industrial products; tents, awnings, lawn furniture.

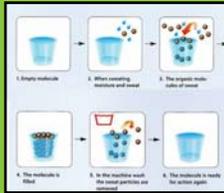
Biological Control Finishes

- ◉ Antimicrobial, antiseptic, antibacterial, or bacteriostatic finishes
- ◉ Inhibit bacterial growth; prevent decay; prevent perspiration damage; control disease spread; reduce infection risk
- ◉ Chemical treatment (quaternary ammonium compounds), gas treatment (ethylene oxide gas) or irradiation



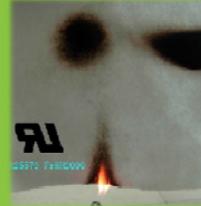
Biological Control Finishes

- **Microencapsulated finishes:** Fragrance, insect repellent, disinfectant, cleaning agent, etc. in tiny capsules sprayed onto and bonded to fabric; semi-durable; applied to furnishings, apparel, protective clothing.



Safety-Related Finishes

- **Flame retardant finishes:** Prevent flame spread.



- **Flame retardance:** Material resists combustion when tested at specified conditions.
- **Flame resistance:** Flaming combustion is prevented, terminated, or inhibited following application of an ignition source, with or without subsequent removal of ignition source.

Flammability

- Material characteristic that pertains to its relative ease of ignition and relative ability to sustain combustion.
- Topical finish
 - May change hand; affect abrasion resistance; needs special care; costs more
 - Temporary if water soluble; more durable if water insoluble
- Ways of achieving flame retardant fabric
 - Inherently flame retardant fibers
 - Flame retardant fiber modifications
 - Flame retardant finishes

Safety-Related Finishes

- **Liquid barrier protective finishes:** Protect wearer from hazardous liquids.
 - In medical applications, protects from viral and bacterial pathogens in body fluids.
- **Pesticide protective finishes:** Nonabsorbent; Protects wearer from liquid pesticides penetration.
- **Light reflective finishes:** Increase visibility of wearer at night.
 - Fluorescent dyes and retroreflective tapes with tiny glass spheres or prisms bonded on surface.
 - Semi-durable for active wear, footwear, and some fashion wear.



Summary

- A finish is anything done to fiber, yarn, or fabric either before or after fabrication to change the appearance, hand, and performance of the fabric.
 - The finish can be applied during any stage of fabric creation – from fiber preparation to final garment stage
- Finishes can be divided into 3 categories according to how they affect the product:
 - **Preparatory:** helps prepare the textile for production; includes slashing, desizing, biopolishing, bleaching, optical whitening, scouring, crabbing, singeing, carbonizing, and mercerization.
 - **Aesthetic:** always visible; creates a visual or textural affect on the textile; includes dyeing, printing, glazing, moiré, embossing, parchmentizing, burn out, flocking, embroidering, shearing, brushing, fulling, sizing, schreiner, chemical wash, plisse, caustic treatment, sueded, and tufted
 - **Functional:** sometimes, but not usually visible; intended to improve performance of textile; includes shrink control, shape retention, durable press, stain resistance, abrasion resistance, water repellent, biological control and flame resistant finishes

- Finishes have different life spans as well
 - **Permanent:** for life of product
 - **Durable:** for life of product, diminishes with time
 - **Temporary:** until conclusion of first cleaning cycle
 - **Renewable:** can be renewed
- **Tentering:** Straightens and dries fabric; held between pins or clips, heated in oven; impact on fabric grain.
- **Calendering:** metal rollers used in textile finishing for pressing, adding texture (moiré, shreiner, embossing, printing...)