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?

Finishing: An Overview

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

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

Finishes

- Finishes
  - Visible (can be seen)
  - Invisible (see effect)

- Processing:
  - Chemical or wet
  - Mechanical or dry

- 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
**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.
- Minimize water use (foam & solvent finishing) or reclaim, recycle, & reuse water.
- 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
- **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 (degaze): Print chemical on fabric that dissolves one fiber.

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

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

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
- 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
- **Crepeing**: Special compacting process for hand, comfort stretch, and drape.
- **Fulled**: Controlled shrinkage (compacted) of wool fabrics; improved hand and appearance.
- **Beetled**: Mechanical flattening of yarns to make weave appear tighter.
  - Damask, crush
- **Coronized**: Heat setting, dyeing, and finishing glass fiber.
- **Emerized, sueded, or sanded**: Fabric abraded to create soft hand.
  - Peach skin look
- **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

### 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
- 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 Finish**
- **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.
- **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 silicons
  - 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
- **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.

- **Porosity control (air impermeable) finishes**: Limit penetration of air.
- **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

- **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)

- **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 (peroxide oxide gas) or irradiation
**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.

**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.

**Flame retardant fiber modifications:**

**Flame retardant finishes:**

**Liquid barrier protective finishes:** Protect wearer from hazardous liquids.

**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, mercerizing, bleaching, optical whitening, scouring, crabbing, singeing, carbonizing, and mercerization.
  - *Structural:* always visible; creates a visual or textural effect on the textile; includes dying, printing, glazing, moiré, embossing, bronzing, flocking, embroidery, shearing, brushing, fulling, sizing, schreiner, chemical wash, plisse, or caustic treatment, sueded, or 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.

**Safety-Related Finishes**

- **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...).