Preparation and scouring wool and wool blends

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Overview of subject

- Preparatory processes
- Principles of scouring
  - **detergents and detergency**
  - **influence of water quality**
- Machinery
- Setting of wool and its blends
  - **machine requirements**
- Carbonising
- Non-shrink, non-felting wool
- Yarn preparation

Preparatory processes

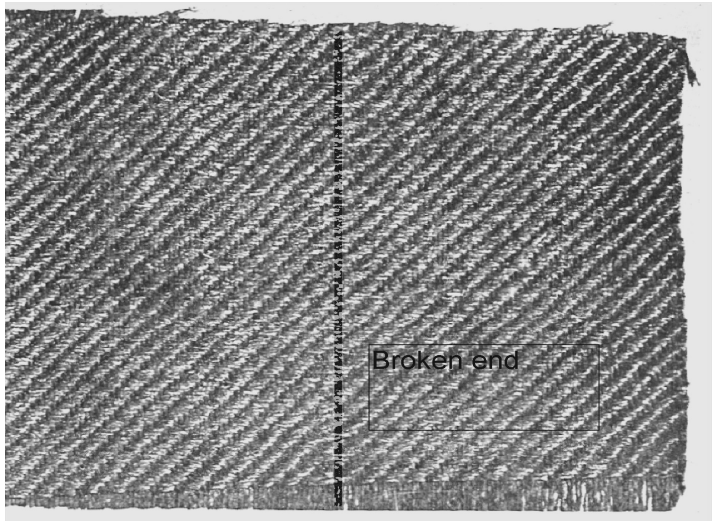
- 70% of all faults due to inadequate and poor preparation
- Appearance and handle required in the finished cloth
- Preparation is the key to:
  - finished quality
  - appearance
  - final value

Preparatory processes

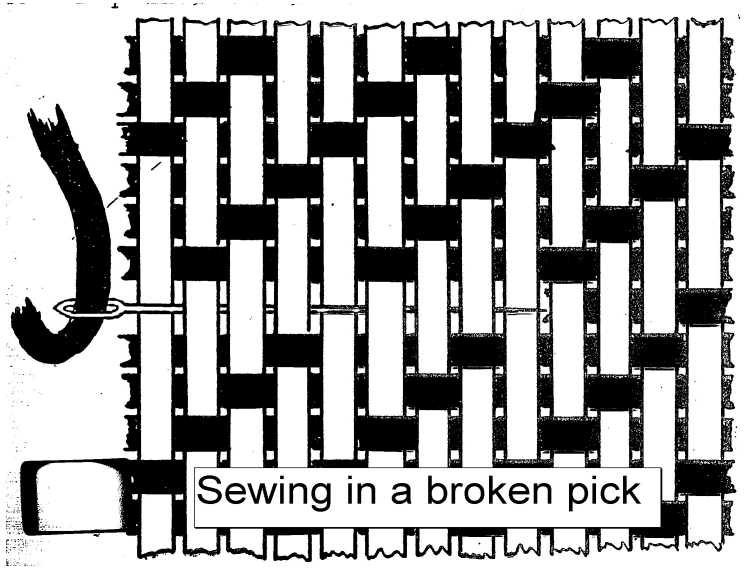
- Examination for faults, knots, broken ends and picks
- Evaluation of the structure of the cloth
- Quality and type of materials used in the fabric

Typical faults found in griege fabric

- Broken end



- Repairing a broken pick



Impurities in griege fabrics

- Spinning lubricants
  - modern lubricants are easily removed
- Oils from either weaving or knitting
  - often mineral oil-based
  - if the fabric has been standing, the oils may have oxidised and are more difficult to remove
- Floor dirt

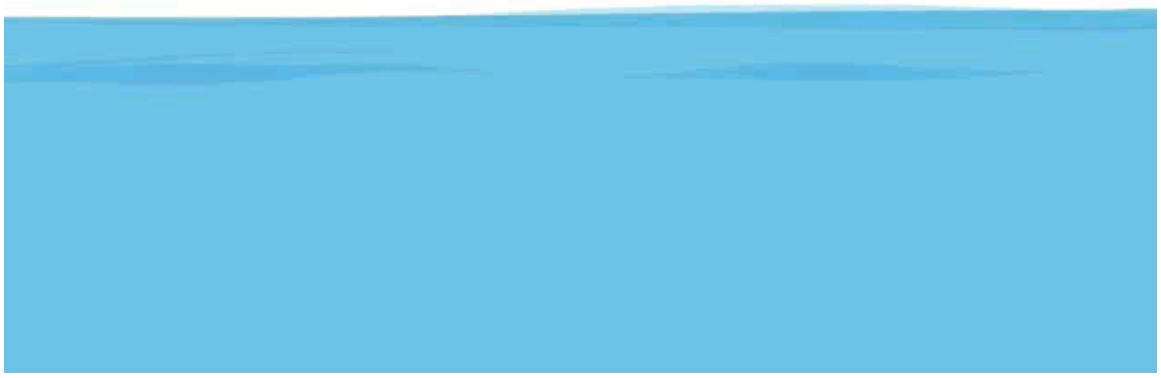
Major requirements in scouring

- Scouring is both a mechanical and chemical process
- Saturation of the fabric with the scouring liquor, efficient wetting is required
- Emulsification or saponification of the oils, and maintaining a stable system
- Compression to squeeze the liquor into the cloth and remove the dirt particles

Detergent types

- Earliest systems used soap and sodium carbonate
- Modern systems use non-ionic and blends of non-ionic detergents with anionic products, i.e. sulphated fatty alcohols
- Non-ionic surfactants should be chosen with the correct HLB value
- HLB values of 5 moles ETO, good emulsifiers but poor wetting agents. 8-10 moles ETO have better wetting and scouring properties

Formation of micelles



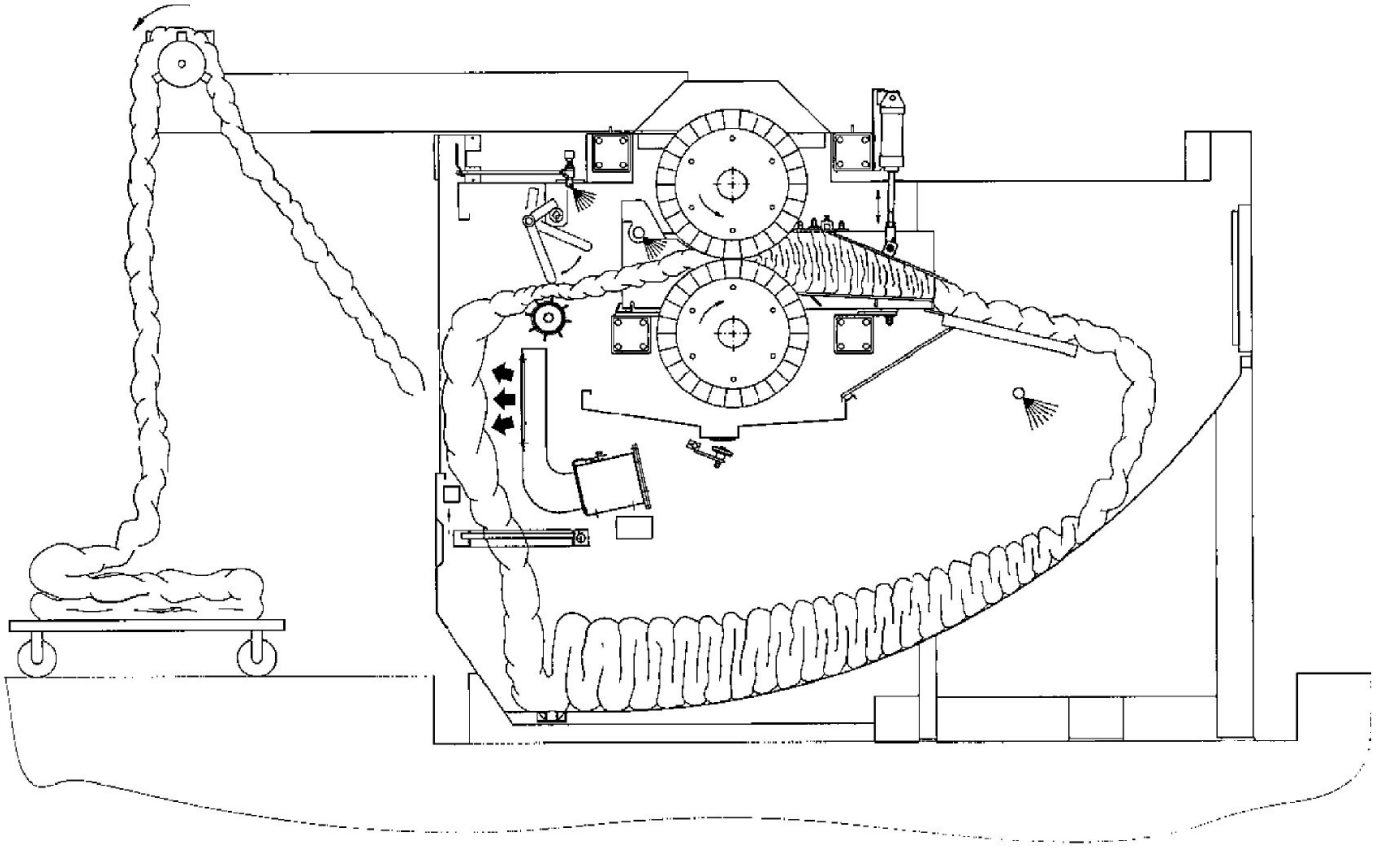
Water quality and scouring

- Presence of Ca^{2+},Mg^{2+} & suspended solids can create defects
- Hard water is inefficient as more detergent is required
- Best quality water should be 0 to 3° hardness
- Sequestering agents can be used:
  - sodium hexa meta-phosphate, methyl phosphonate types
  - low molecular polyacrylates are also effective
- Water treatment is often required:
  - base exchange resin systems remove ca^{2+}, mg^{2+}
  - filtration to remove suspended solids

Machinery

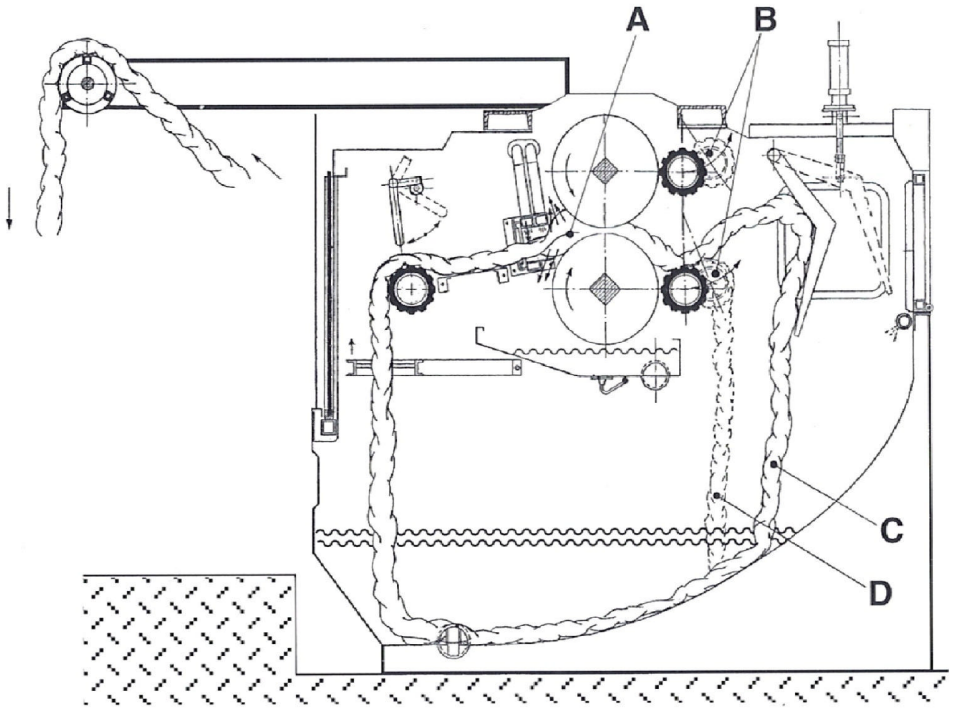
- Wide variety of machines is available
- Batch scouring machines, rope scouring
- Combined scouring and milling machinery
- High-speed rope scouring
- Open-width scouring
- Continuous and solvent scouring

Flexicom Machine - Zonco

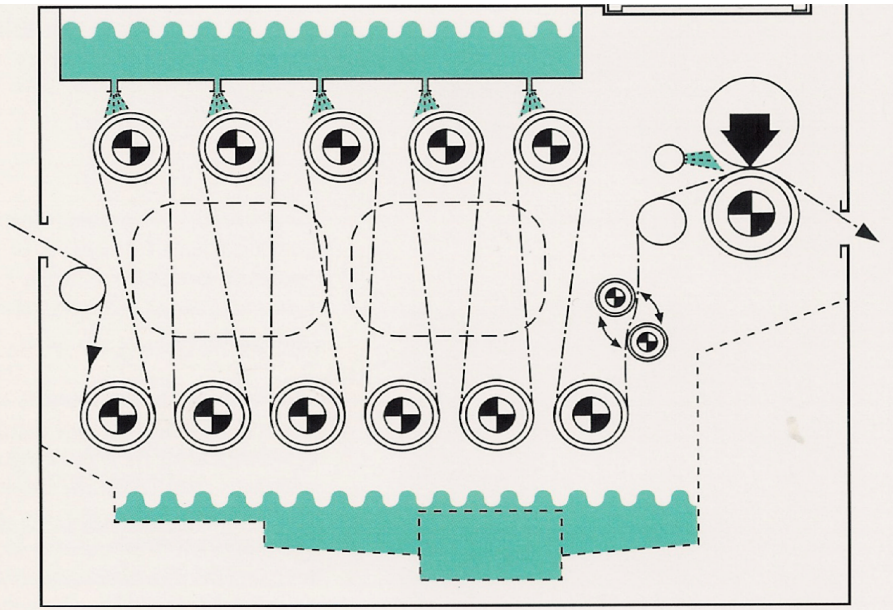


High-speed rope scouring - Zonco

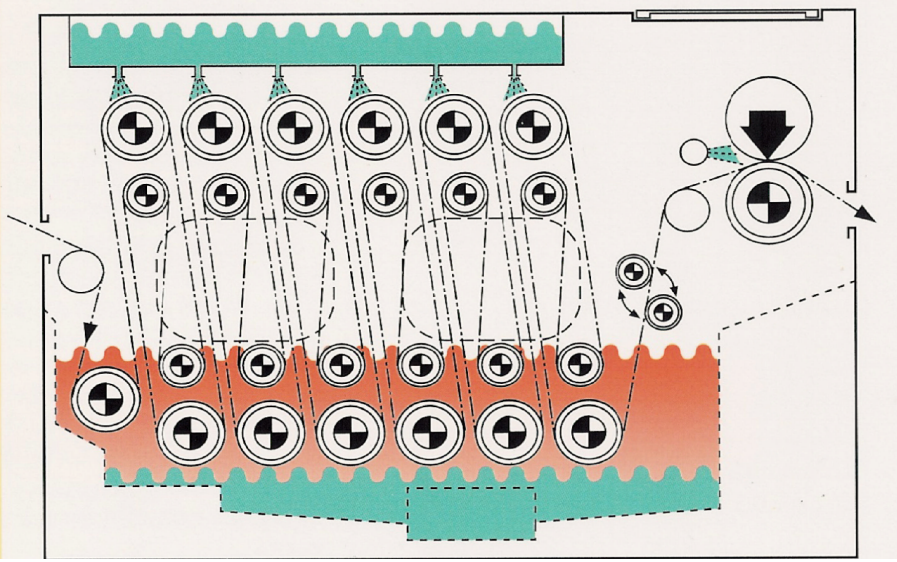
A "Swelling zone" between the spraying device and the squeezing rollers
B Double safety device little rollers winding up
C Rapid washing with fulling
D Rapid washing in rope form or in sack sewn rope



Open-width scouring - Zonco



Sezione vasca di lavaggio / risciacquo
Section of washing / rinsing unit
Section du bac de lavage / rinçage
Schnitt vom Trog fürs Waschen / Spülen
Sección unidad de lavado / aclarado

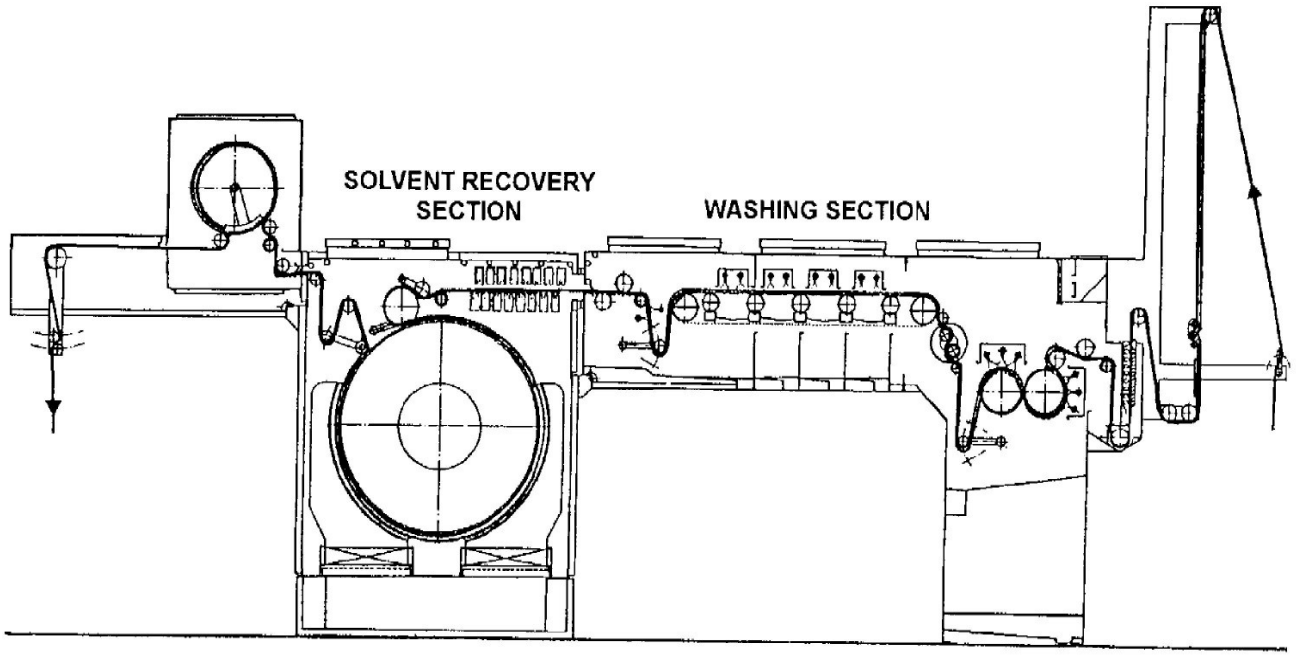


Sezione vasca di fissatura / stabilizzazione
Section of crabbing / stabilizing unit
Section du bac de fixage / stabilisation
Schnitt vom Trog für Fixierung / Stabilisierung
Sección unidad de fijado / estabilización

Open-width scouring machine courtesy Zonco, Italy

Courtesy Zonco, Italy

Solvent scouring, Spirotto Rimar



A Nova (Spirotto Rimar) solvent scouring machine

Blends of wool with polyester

- Pre-setting prior to dyeing 160° sufficient to withstand dyeing temperature of 120°
- Setting in griege is not recommended:
  - presence of oils and dirt in griege fabrics
  - would be difficult to remove in subsequent scouring
- Solvent scoured fabrics can be set directly
- Scour in open width to relax stresses
- A pre-drier is necessary if drying and setting from the wet

Permanent set of wool

- Objective of setting wool is to:
  - prevent creases forming in wet processing
  - prevalent in 100% wool fabrics that high twist yarns and high loom sett.
- Woollen fabrics do not require setting due to lower twist yarns and lower loom sett.
- To obtain true permanent sett the fabric must be treated with either steam or boiling water.
- Treatment in cold water only gives temporary sett.

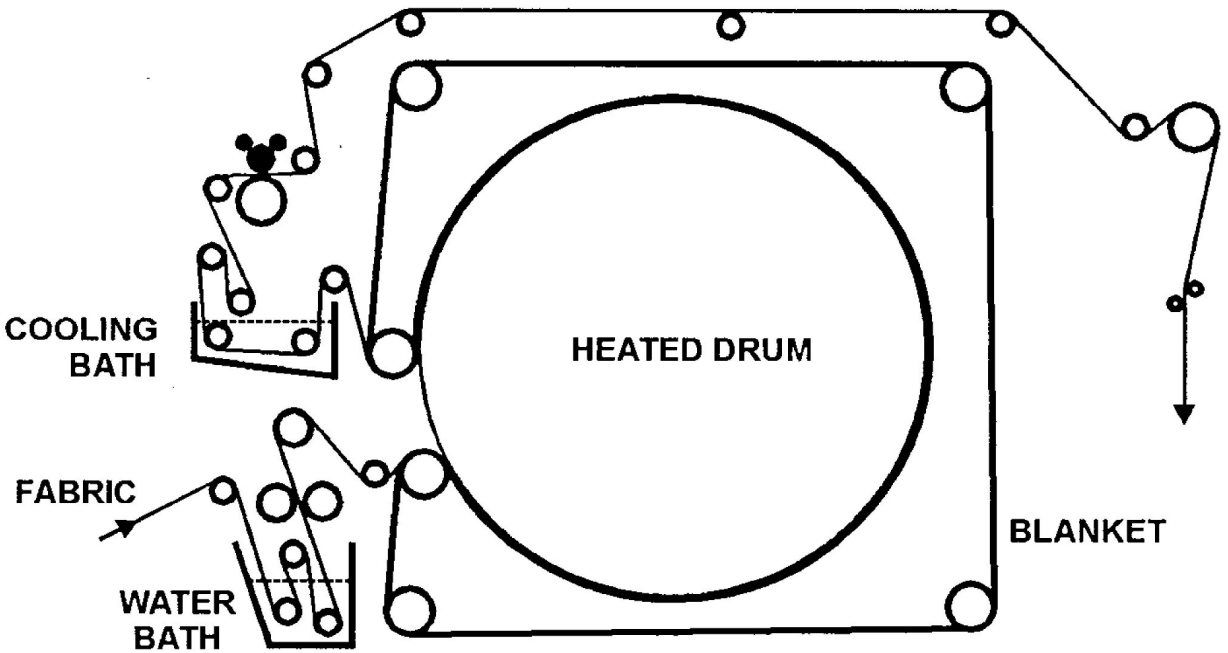
Setting process

- Crabbing consists of treating the fabric under tension.
- During the process:
  - a definite position is imposed on the fibres and yarns in the warp and weft
  - this reduces the chances of uneven fibre movement in later processing
  - brings the stresses in the fabric into equilibrium.
- Crabbing prevents irregular shrinkage that may cause creasing and cockling.
- Pressure and tension must be controlled to prevent watermarking and poor handle.

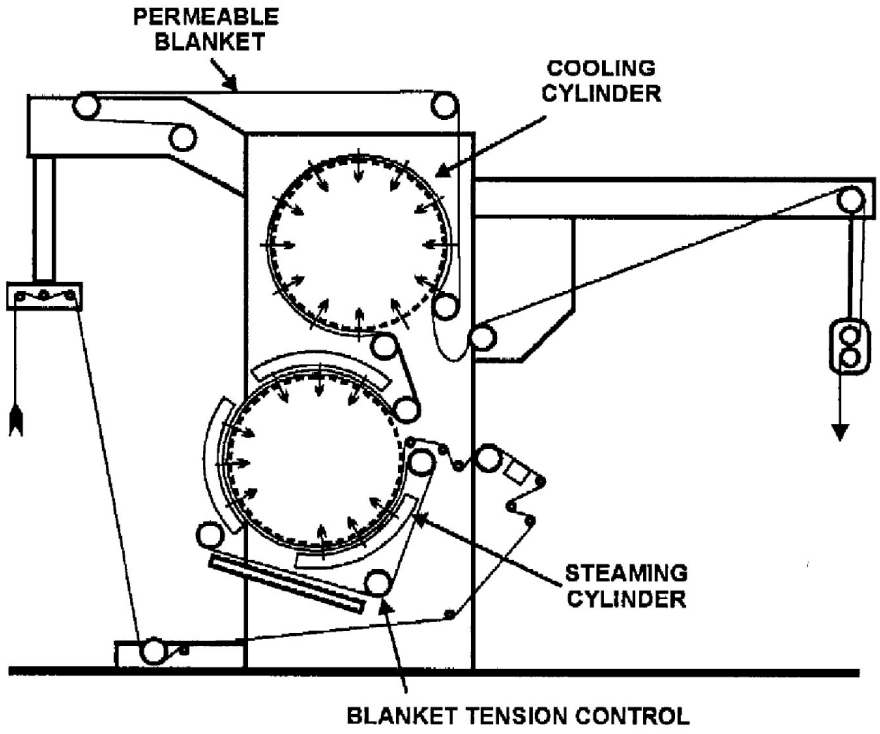
Methods of setting (crabbing)

- Blowing with steam
  - Fabric under tension is wound onto a perforated roller
  - Steam is then passed though the fabric
- Boiling
  - Fabric is wound under tension through boiling water
- Pressure decatising
  - Similar process to blowing with steam, except under pressure
- Treatment in boiling water on a jigger
- Continuous crabbing machines

Continuous crabbing machines



Continuous decatising machine



Carbonising

- Carbonising usually on scoured wool
- Woollen fabrics from shoddy (reclaimed fibre) are piece carbonised
- Wool is reasonably stable to mineral acids
- Controlled conditions of temperature and concentration are important

Carbonising process

1. Impregnate fabric with H_2SO_4 or HCl.
2. Squeeze out excess liquor.
3. Dry to remove excess moisture.
4. Heat to form hydrocellulose .
5. Dry mill to remove hydrocellulose char.
   - Quality is determined by:
     - acid concentration
     - fabric condition after impregnation
     - temperature and time of heating.

- Uneven dyeing can result from uneven carbonising in the piece.
- The methylene blue test will show acid damage of the wool. If the fibre is acid damaged, there is less affinity for acid dyes and greater affinity for basic or cationic dyes.
- Carbonising wool in the loose form - unevenness is usually not a problem as thins can be overcome by blending.

Non-shrink wool

- **Two processes are used**
  - For top - treatment with gaseous chlorine (the Kroy Process) - a continuous process
  - Wet chlorination using the sodium salt of di-chloro-isocyanuric acid (Basolan DCTM BASF)
- **Chlorination modifies the surface scale structure**
  - A cationic resin Hercosett is usually applied as an aftertreatment
  - The resin treatment covers any scales that have not been completely damaged

- Other methods that have been used:
  - resin treatment to reduce fibre elasticity
  - treatment with sodium hypochlorite
  - permonosulphuric acid.
- Hercosett Resin is cationic the dyeing properties are different to both chlorinated and normal wool. Acid dyes have higher dyeing rates.
- Careful control of the process is required to prevent yellowing.

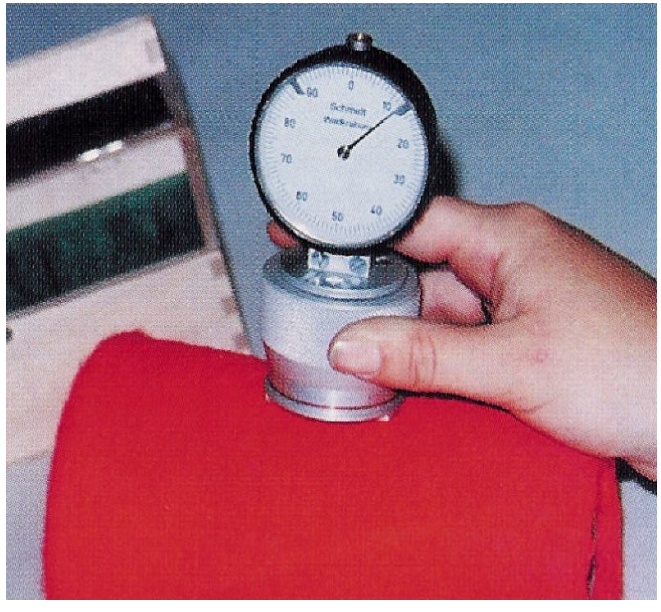
Piece chlorination

- Careful control on knitted and woven fabrics to prevent uneven dyeing.
- Woven fabrics should be processed in open width, usually using a jigger.
- Knitted fabrics are best processed on a beam dyeing machine.

- **Processing in rope form is not recommended**.

Yarn preparation

- Package dyeing
  - Package density can be controlled using the SDL Atlas™ Package Density Meter.



Yarn Package Classifier & Analysis System
SDL Atlas

Typical specification for staple yarns

Package weight	1.6 kg
Package diameter	220 mm
package centre diameter	69-72 mm
Package traverse	190 mm
Angle of traverse wind	12°
Package density	200 g/l
Spindle density of packages after press packing on column	260 g/l

(J. Park, *A Practical Introduction to Yarn Dyeing*, SDC 1981)

- Steam setting prior to dyeing will prevent unevenness
- Typically, in to out variations due to shrinkage
- Mechanical packing of the spindle is best:
  - giving increased material weights
  - reduced package density variations
  - minimal liquor channelling

- Tape scouring machines are used to remove spinning lubricants, particularly in carpet yarns
- Residual detergent can cause hanks to float, particularly in single stick machines, i.e. Husong

- A wide variety of centres are used for package dyeing:
  - plastic – short life, can be stained by dyes
  - metal – more robust, longer life, easily cleaned

Mechanical loading gives the best results, giving increased loads, and reducing liquor channelling.

Example of unlevelness

Channelling due to density variations

Levelling agents for dyeing

- Two main types:
  - fibre reactive
  - dyestuff reactive

Fibre reactive types

- Sodium sulphate the most common
- Sodium di-naphthyl methane sulphonate - stronger retarding action cf. Na_2SO_4, more effective for premetallised dyes

Dye reactive types

- Based on amphoteric surfactants, i.e. amine ethoxylates
- Form weak cationic complexes with the dye
- Have strong retarding action – can reduce final exhaustion
- Have a very important role in the dyeing of reactive wool dyes
- When used in excess can be used to reduce depth of shade

Conclusions

- Preparation is a key element to the production of quality fabrics.
- Choice of machinery influences quality.
- Correct choice of detergents.
- Setting, carbonising, shrink resist processes.
- Yarn preparation is all important for consistent results.