



MATA KULIAH

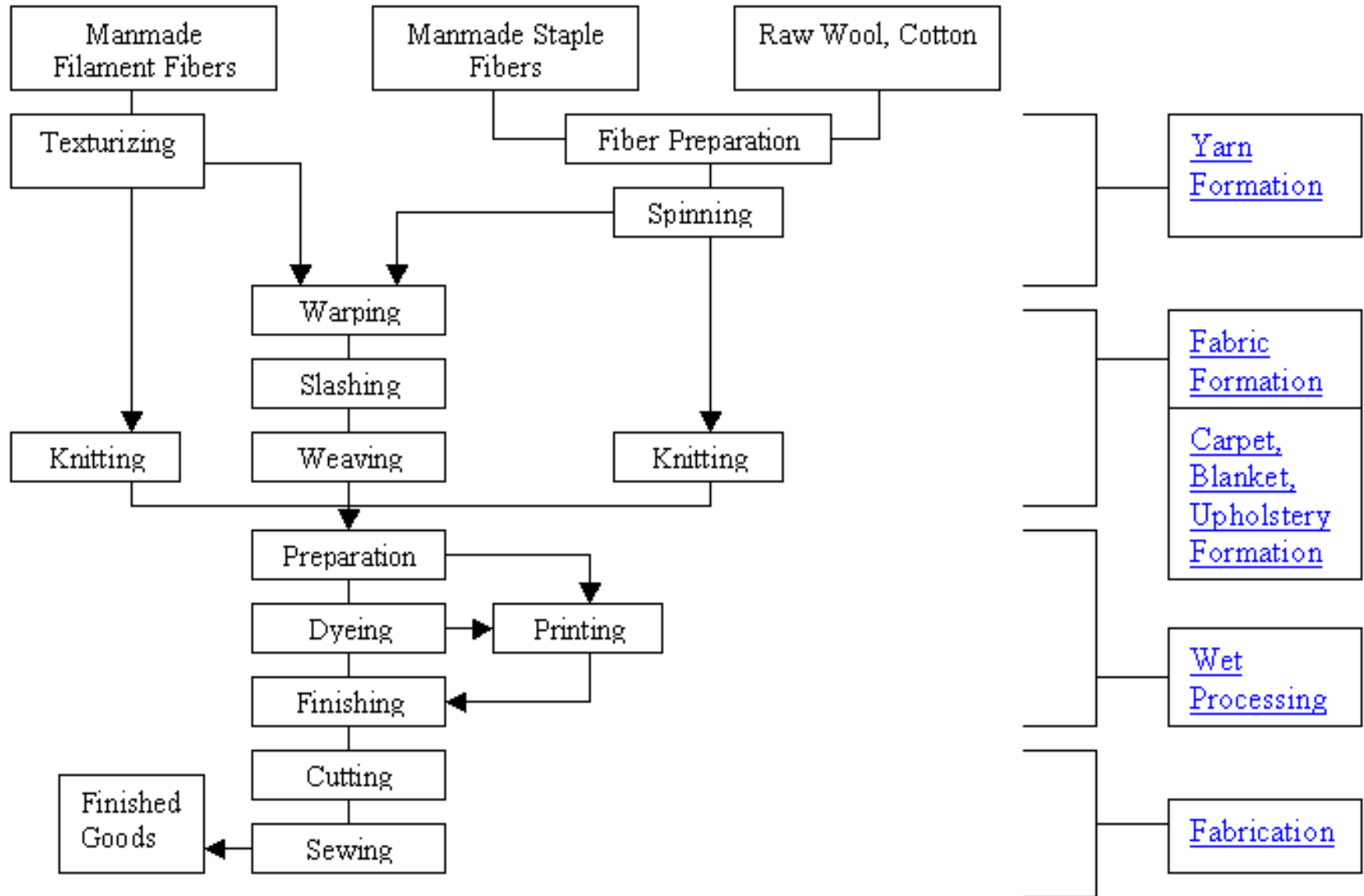
TEKNOLOGI TEKSTIL

3 SKS

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Jurusan Pendidikan Teknik Busana FT UNY

TEKSTIL MANUFAKTUR



APLIKASI PRODUK TEKSTIL

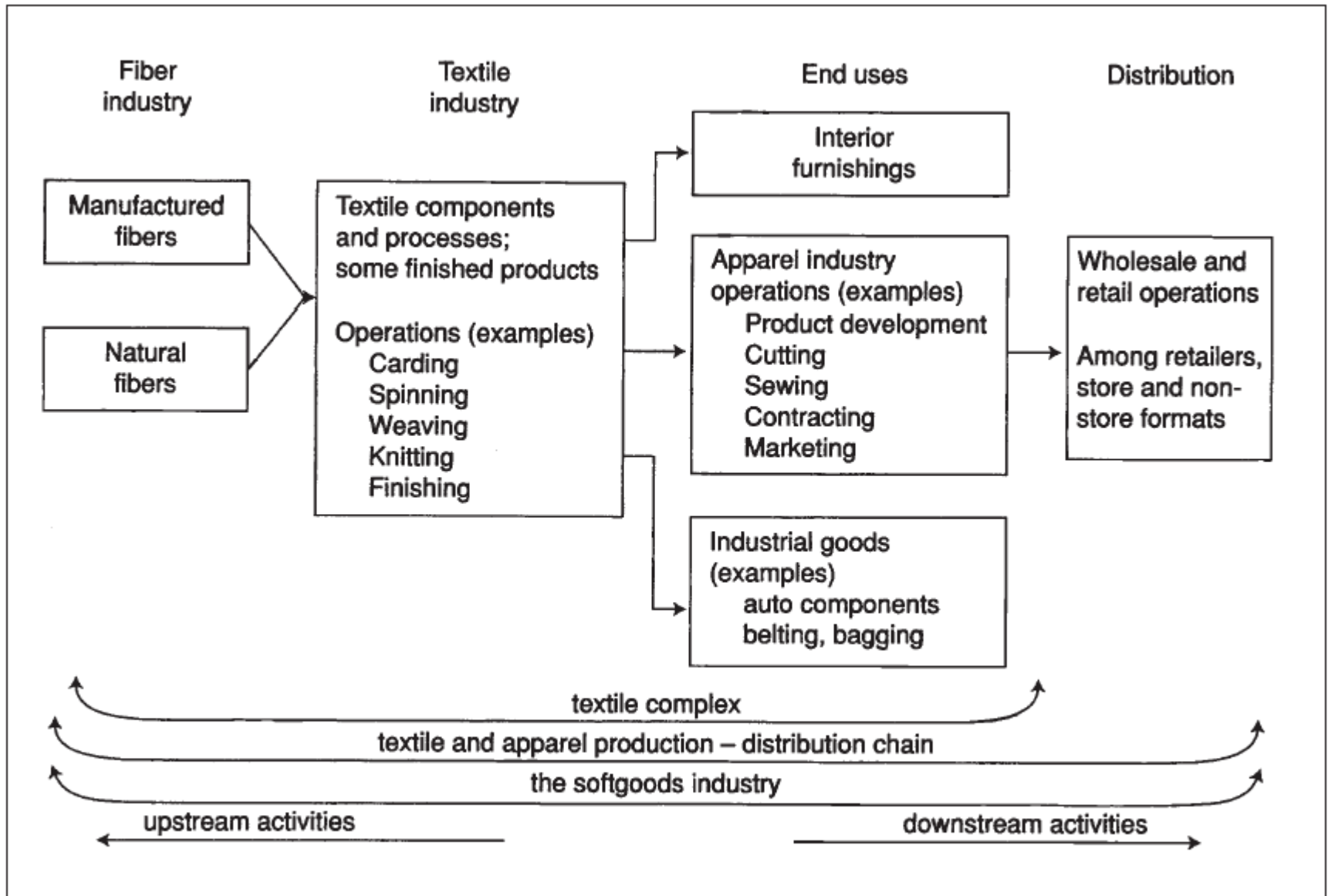


Figure 1. Diagram of the Textile Complex and Related Industries. From K. G. Dickerson, *Textiles and Apparel in the Global Economy*, 3rd ed. (Upper Saddle River, N.J: Prentice-Hall, Inc., 1999).

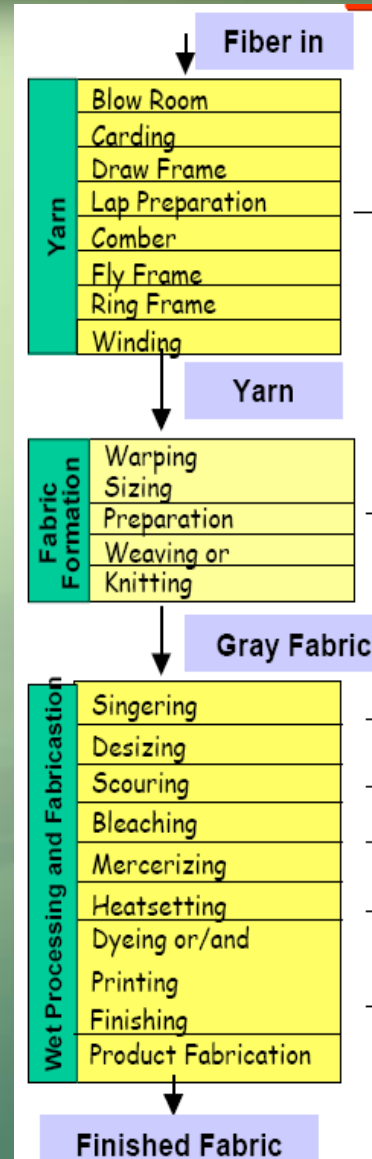
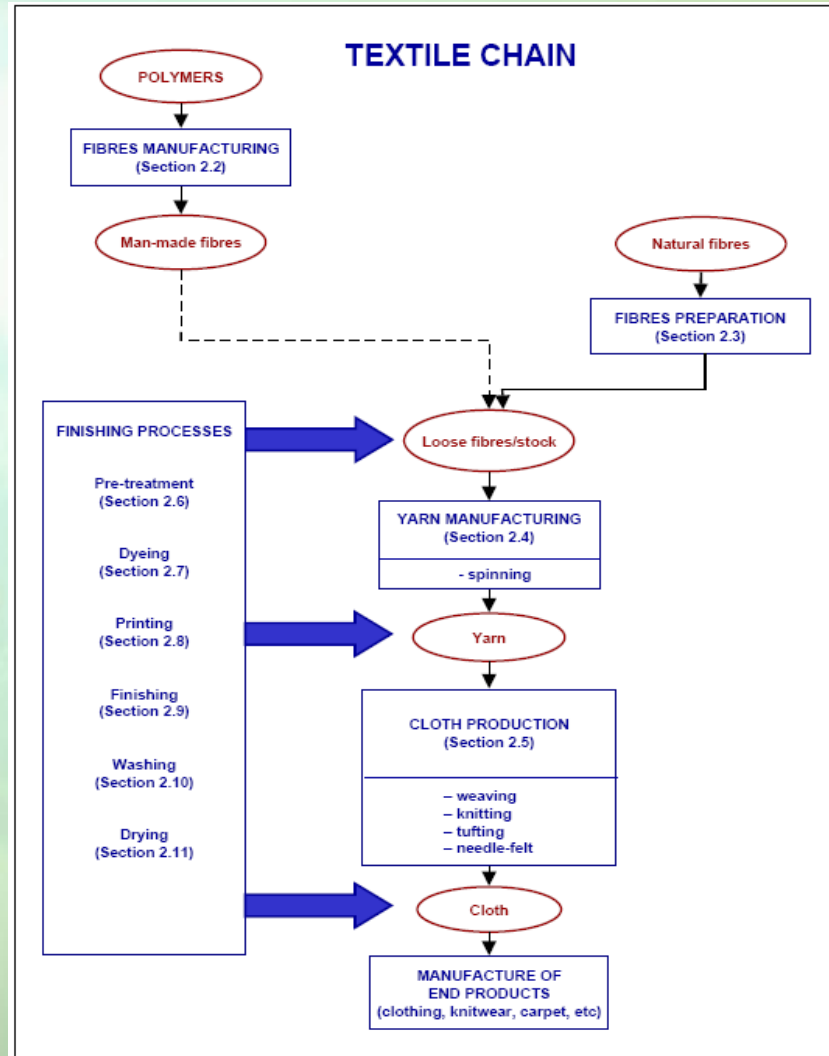
Ruang Lingkup Teknologi Tekstil

Five main sectors of textile industry:

- Fiber production
- Spinning
- Weaving and knitting
- Dyeing-printing and finishing
- Garment production

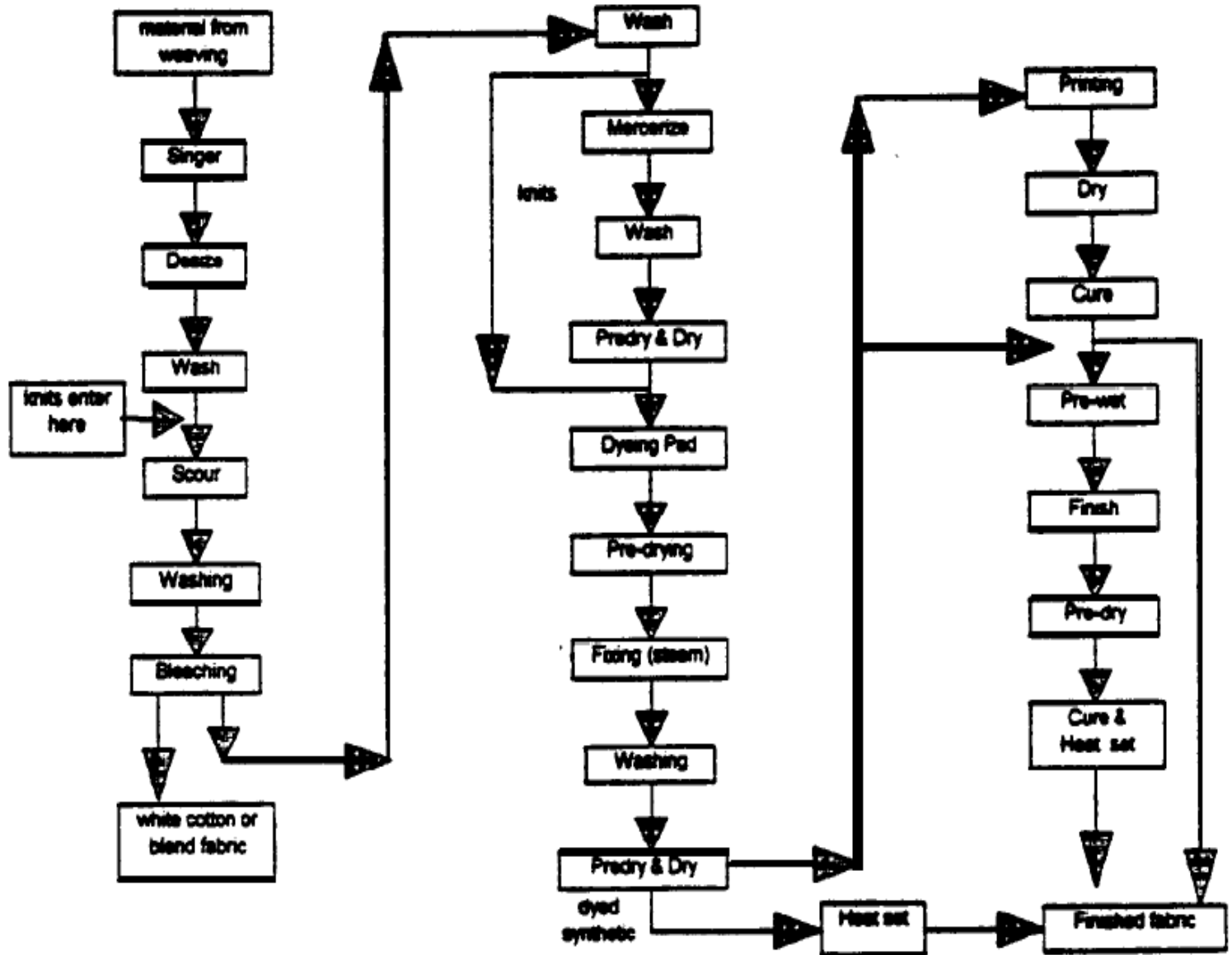
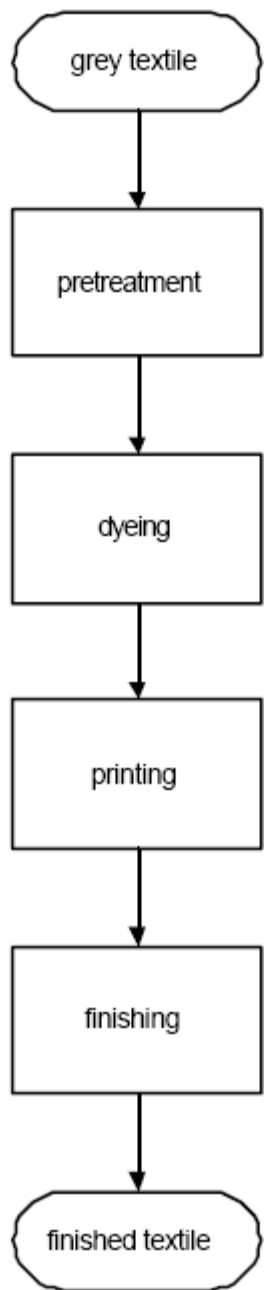
Klasifikasi serat tekstil

| | |
|-----------------------|---|
| Natural fibres | <ul style="list-style-type: none"> • Animal origin <ul style="list-style-type: none"> Raw wool Silk fibre Hair • Vegetable origin <ul style="list-style-type: none"> Raw cotton fibre Flax Jute • Mineral origin <ul style="list-style-type: none"> Asbestos |
| Half-synthetic fibres | <ul style="list-style-type: none"> • Vegetable origin <ul style="list-style-type: none"> Viscose, cupro, lyocell Cellulose acetate Cellulose triacetate • Mineral origin <ul style="list-style-type: none"> Glass for fibre glass Metal for metal fibre |
| Synthetic fibres | <ul style="list-style-type: none"> • Petrochemical origin <ul style="list-style-type: none"> Polyester (PES) Polyamide (PA) Polyacrylonitrile (PAC) Polypropylene (PP) Elastane (EL) |



Proses Finishing

Pre treatment, Pencelupan, Pencapan dan Finishing



Jenis-Jenis Proses Pre Treatment

FABRIC PRETREATMENT

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graph TD; A[FABRIC PRETREATMENT] --> B[mechanical]; A --> C[thermal]; A --> D[wet]; B --- B1[brushing]; B --- B2[raising]; B --- B3[shearing]; B --- B4[beating]; B --- B5[etc.]; C --- C1[heat setting]; C --- C2[singeing]; D --- D1[washing]; D --- D2[desizing]; D --- D3["scouring (kier boiling)"]; D --- D4[mercerizing]; D --- D5[bleaching]; D --- D6["optical bleaching"]; D --- D7[carbonizing]; D --- D8[felting]; D --- D9[antifelting]; D --- D10[etc.];
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mechanical

brushing
raising
shearing
beating
etc.

thermal

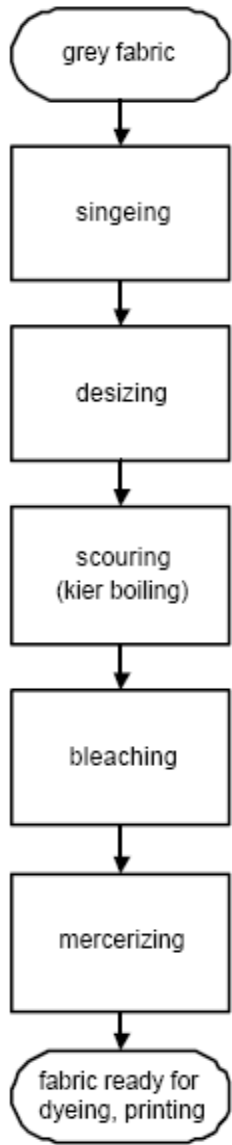
heat setting
singeing

wet

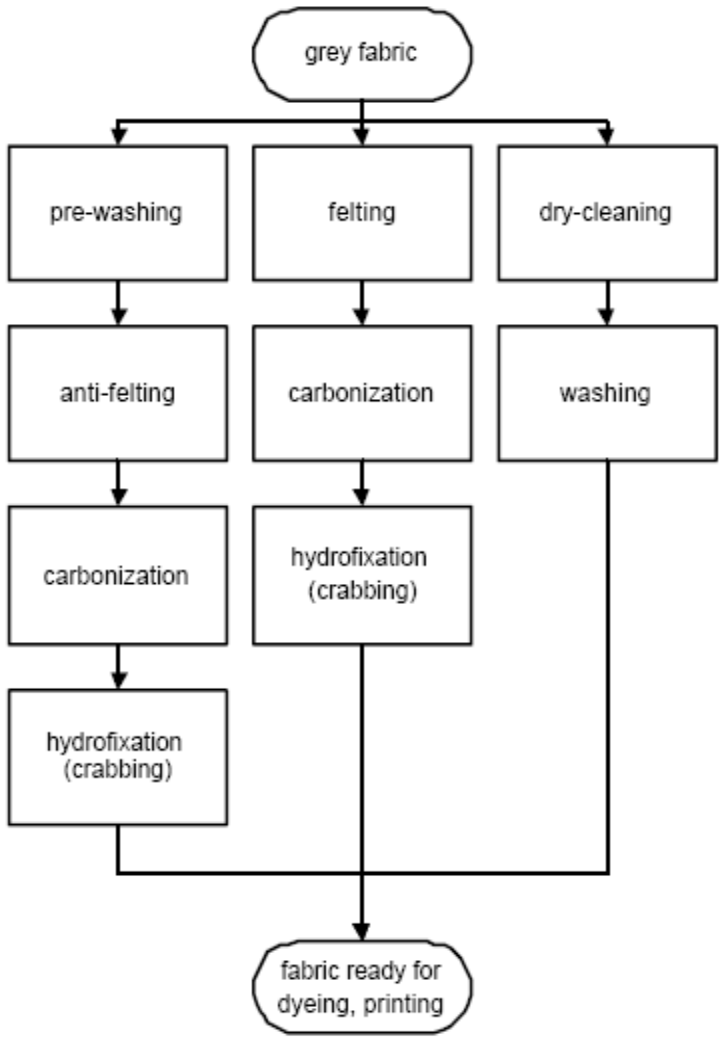
washing
desizing
scouring (kier boiling)
mercerizing
bleaching
optical bleaching
carbonizing
felting
antifelting
etc.

Proses Pre Treatment Berbagai Jenis Serat

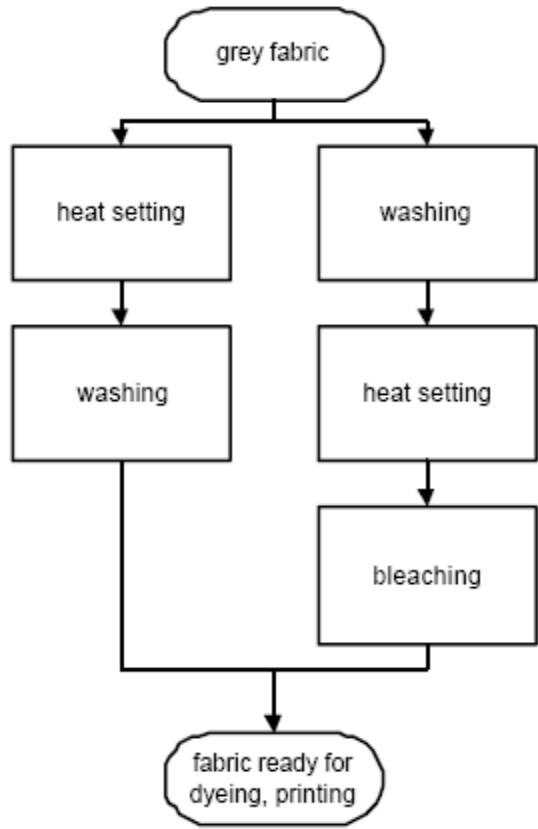
COTTON



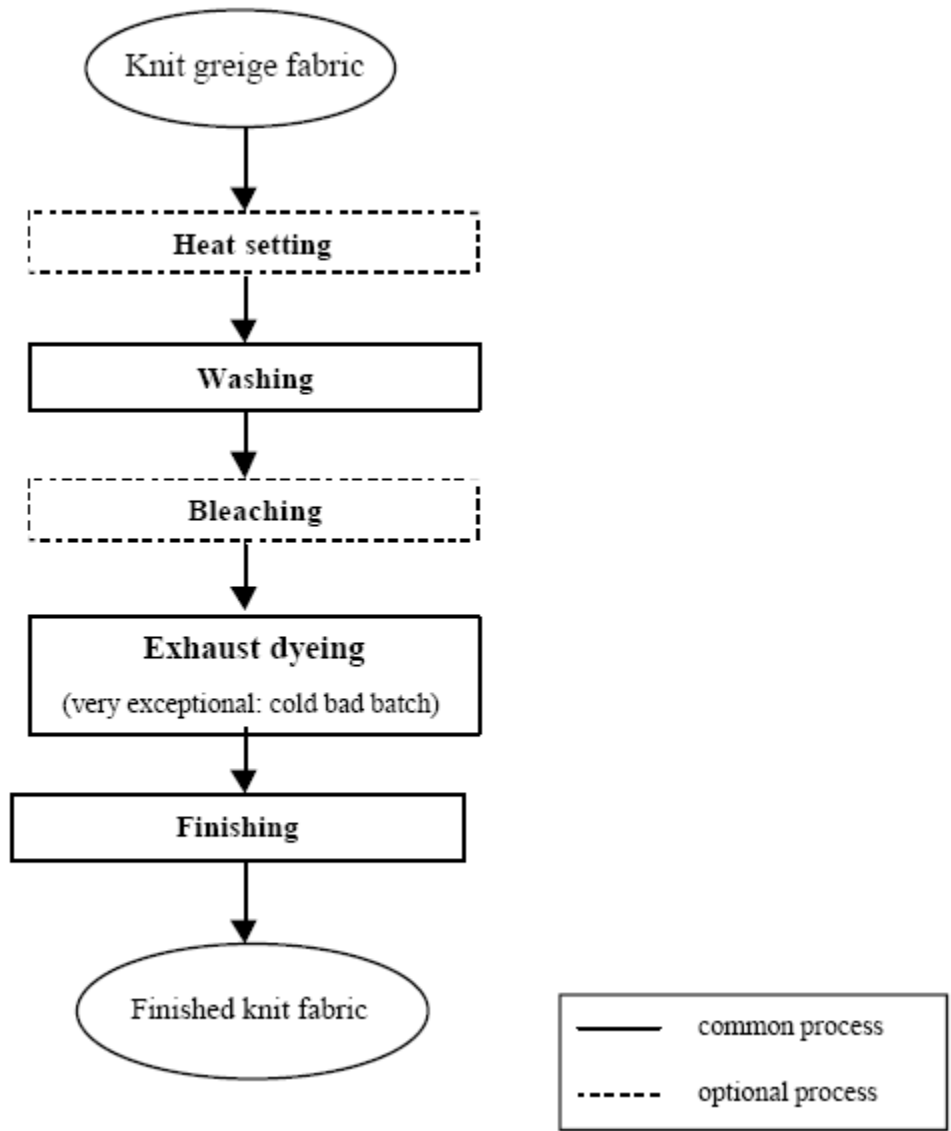
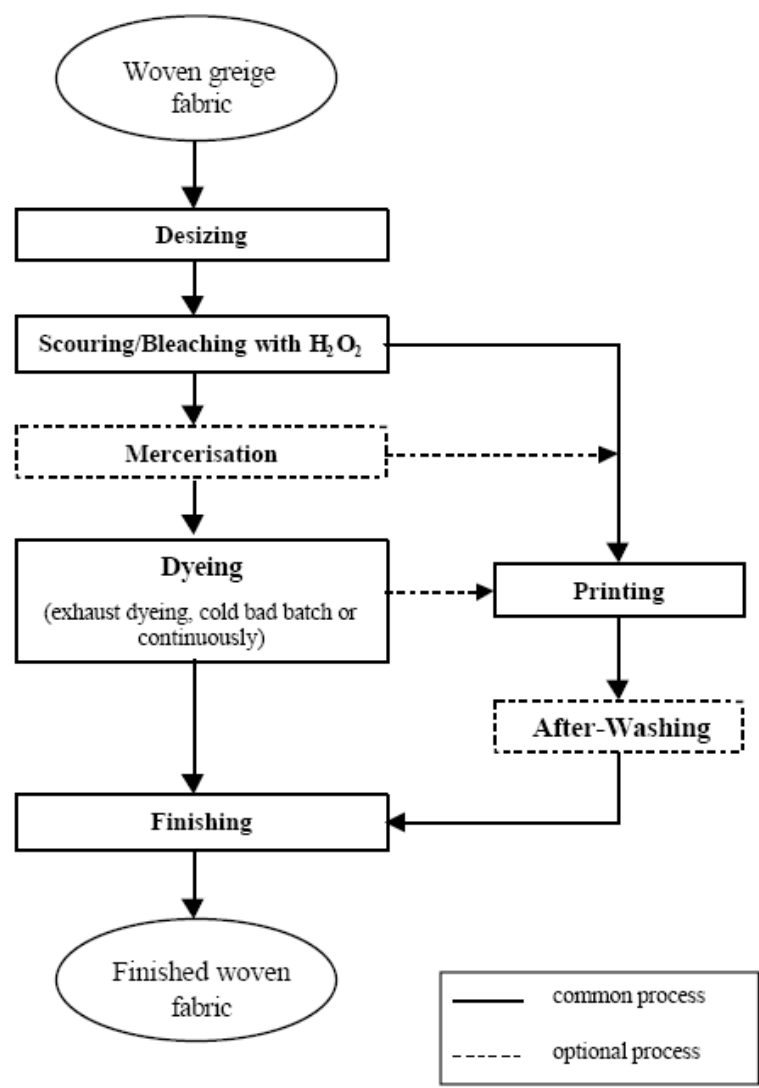
WOOL



MAN-MADE FIBRES



Proses Penyempurnaan akhir kain tenun dan rajut



Jenis zat warna dan obat bantu dalam proses pencelupan

| Dyestuff | Chemicals and auxiliaries/ typical application conditions | Technique |
|----------|--|--------------------|
| Reactive | <ul style="list-style-type: none"> - pH 9.5 - 11.5 by addition of sodium carbonate and/or sodium hydroxide - Salt is used to increase dye bath exhaustion: higher concentrations are used for low-affinity dyes and for deep shades - Application temperatures vary from 40 °C to 80 °C depending on the class of the dyestuff - In padding processes urea or cyanoguanidine is usually added to the pad liquor - After dyeing, the material is soaped at 100 °C and then washed off with addition of surfactants to remove unfixed dye | Batch |
| | | Pad-batch |
| | | Pad-steam |
| | | Pad-dry |
| Direct | <ul style="list-style-type: none"> - Salt is used to increase bath exhaustion - Mixtures of nonionic and anionic surfactants are used as wetting/dispersing agents - After-treatment is usually necessary to improve wet-fastness (possible use of fixative cationic agents, formaldehyde condensation products) | Batch |
| | | Pad-batch |
| | | Pad-jig |
| | | Pad-steam |
| Vat | <ul style="list-style-type: none"> - Alkali and reducing agents (sodium dithionite, sulphylic acid derivatives, thiourea dioxide, organic reducing agents) are applied to convert the dye to the sodium leuco form - Poorly degradable dispersants are present in the dye formulation and are further added in other steps of the process - Levelling agents are sometimes necessary - Temperature and the amount of salt and alkali required vary according to the nature of the dye (IK, IW, IN) - Dye is fixed to the fibre by oxidation, generally using hydrogen peroxide, but halogen-containing oxidising agents can also be used - After-treatment takes place in a weakly alkaline detergent liquor at boiling temperature - In continuous processes, anti-migration and wetting agents are used | Batch |
| | | Pad-steam |
| Sulphur | <ul style="list-style-type: none"> - Reducing agents (Na₂S, NaHS, glucose-based combination of reducing agents) and alkali are applied to convert the dye into soluble form, unless ready-for-use dyes are used - Dispersants and complexing agents are used in batch dyeing - In batch dyeing, the dye generally absorbs at 60 - 110 °C, while in the pad-steam process the material is padded at 20 - 30 °C and then subjected to steaming at 102 - 105 °C - Oxidation is carried out mainly with hydrogen peroxide, bromate and iodate | Batch |
| | | Pad-steam |
| | | Pad-dry/ pad-steam |
| Naphthol | <ul style="list-style-type: none"> - Preparation of the naphtholate (caustic soda and, in some cases, addition of formaldehyde is required to stabilise the naphthol on the fibre) - Impregnation of the naphtholate by exhaustion or padding processes - Preparation of the diazotised base (with NaNO₂ and HCl) - Developing stage (the textile is passed through the cold developing bath or the developing solution is circulated through the stationary textile in the dyeing machine) | Batch |
| | | Padding methods |

| Dyestuff | Chemicals and auxiliaries/ typical application conditions | Technique |
|----------|---|--|
| Disperse | <ul style="list-style-type: none"> - pH 4 - 5 by acetic acid - levelling agents (aliphatic carboxylic esters, ethoxylated products, combinations of alcohols, esters or ketones with emulsifying agents) - possible addition of complexing agents (EDTA) for dyes sensitive to heavy metals | Batch dyeing at 125 - 135 °C under pressure (HT) |
| | | Batch dyeing below 100 °C |
| | <ul style="list-style-type: none"> - this techniques requires the use of carriers unless modified polyester fibres are employed - pH 4 - 5 by acetic acid - thickeners such as polyacrylates and alginates are added to the padding liquor in order to prevent migration of the dye during drying - after-treatment with a solution containing sodium hydrosulphite and sodium hydroxide (dispersing agents are added to the last washing bath) | Thermosol process |

| | | |
|------------------------|---|------------------------------------|
| Acid dyes | <ul style="list-style-type: none"> - pH conditions from acid to neutral depending on the affinity of the dye - optimal bath exhaustion and level dyeing are achieved by either pH or temperature control methods (levelling agents are also used) - in the acidic range, electrolytes retard the exhaustion - with levelling dyes, wet-fastness is often unsatisfactory and after-treatment with synthanes can be necessary | Batch |
| 1:2 metal-complex dyes | <ul style="list-style-type: none"> - dyes containing sulphonic groups are preferred because they are more water-soluble and produce better wet-fastness - to improve absorption of low-affinity dyes (especially for disulphonic) dyeing is carried out in weakly acidic conditions using acetic acid - high-affinity dyes are applied in neutral or weakly alkaline medium using amphoteric or non-ionic levelling agents | Batch |
| Chrome dyes (mordant) | <ul style="list-style-type: none"> - pH 3 to 4.5 - sodium sulphate - organic acids: acetic and formic acid (tartaric and lactic acids can also be used) - reducing agent: sodium thiosulphate - after-chrome with Na or K dichromate | Batch dyeing (After-chrome method) |
| 1:1 metal-complex dyes | <ul style="list-style-type: none"> - pH 1.8 to 2.5 (pH 2.5 in the presence of auxiliary agents such as alkanolethoxylates) - sulphuric or formic acid - salt: sodium sulphate - ammonia or sodium acetate can be added to the last rinsing bath | Batch dyeing |
| 1:2 metal-complex dyes | <ul style="list-style-type: none"> - pH 5 to 7 - ammonium sulphate or acetate - levelling agents (non-ionic, ionic and amphoteric surfactants) | Batch dyeing |

Sumber-sumber Zat warna alam

Natural Colorants, some typical examples

- Blue - woad *Isatis tinctoria* (Brassicaceae)
indigo *Indigofera tinctoria* (Fabaceae)
cornflower flower *Centaurea cyanus*
bilberry fruits *Vaccinium myrtillus*
fruits of Common Elderberry (*Sambucus nigra*)
European ash (*Fraxinus excelsior*)
- Yellow - turmeric rhizome *Curcuma domestica*
Safflower (*Carthamus tinctorius*)
carrot (*Daucus carota*)
big marigold *Tagetes erecta*
- Orange - sweet peppers, paprika *Capsicum annuum*
annato *Bixa orellana*
saffron red stigmas *Crocus sativus*
bloodroot *Sanguinaria canadensis*
- Green - chlorophyll
- Brown - cocoa *Theobroma cacao*
fermented tea *Camellia thea*
henna *Lawsonia inermis*
- Purple - alkanet root *Alkanna tinctoria*
- Black and brown - carbon and caramel
- Confederate gray - butternuts *Juglans cinerea*
- White - titanium oxide

Zat mordanting

| Common Name | Chemical Name | Use |
|----------------------------------|--|--|
| Alum plus Cream of tartar | Aluminum potassium sulfate Potassium bitartrate | Usually combined in a ratio of 3 parts alum to 1 part cream of tartar |
| Chrome | potassium dichromate | Used to deepen colors and make them more lasting |
| Iron (copperas) | Iron(II) sulfate | used as a saddening agent because it makes a color darker or duller |
| Tin | Tin(II) chloride | used as a brightening agent to make color sharper or lighter |
| Copper sulfate (blue vitriol) | copper(II) sulfate | used to make colors in the green range as it itself imparts a bluish-green color to fibers |
| Vinegar | Acetic acid | used to heighten color of a dye bath, especially with reds |
| Ammonia (non-sudsy, clear) | Ammonia | used to draw colors out of dye materials, especially grasses and lichens |

Sumber-sumber Zat warna alam dan zat mordant

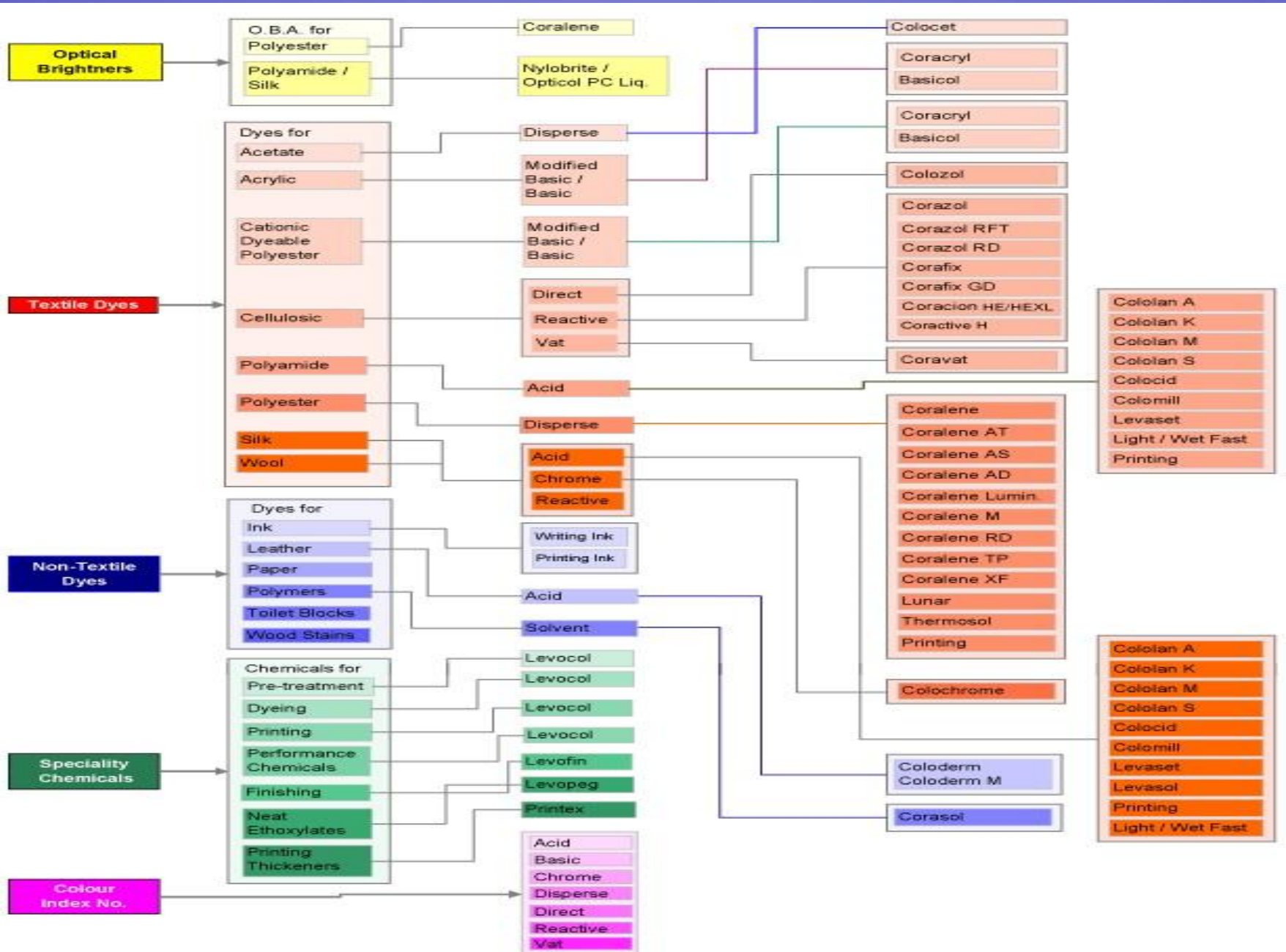
Table 1. Sources of different coloured dyes and mordants²⁰

| Colour | Botanical name | Parts used | Mordants |
|---------------------|--|------------|------------------|
| Red dye | | | |
| Safflower | <i>Carthamus tinctorius</i> L. | Flower | – |
| Caesalpinia | <i>Caesalpinia sappan</i> L. | Wood | Alum |
| Madder | <i>Rubia tinctorium</i> L. | Wood | Alum |
| Log wood | <i>Haematoxylon campechianum</i> L. | Wood | – |
| Khat palak | <i>Rumex dentatus</i> L. | Wood | Alum |
| Indian mulberry | <i>Morinda tinctoria</i> L. | Wood | Alum |
| Kamala | <i>Mallotus philippinensis</i> Muell. | Flower | Alum |
| Lac | <i>Coccus lacca</i> Kerr. | Insect | Stannic chloride |
| Yellow dye | | | |
| Golden rod | <i>Solidago grandis</i> DC. | Flower | Alum |
| Teak | <i>Tectona grandis</i> L.f. | Leaf | Alum |
| Marigold | <i>Tagetes</i> sp. | Flower | Chrome |
| Saffron | <i>Crocus sativus</i> L. | Flower | Alum |
| Flame of the forest | <i>Butea monosperma</i> (Lam) Taubert. | Flower | Alum |
| Blue dye | | | |
| Indigo | <i>Indigofera tinctoria</i> L. | Leaf | Alum |
| Woad | <i>Isatis tinctoria</i> L. | Leaf | – |
| Sunt berry | <i>Acacia nilotica</i> (L.) Del. | Seed pod | – |
| Pivet | <i>Ligustrum vulgare</i> L. | Fruit | Alum and iron |
| Water lily | <i>Nymphaea alba</i> L. | Rhizome | Iron and acid |
| Black dye | | | |
| Alder | <i>Alnus glutinosa</i> (L.) Gaertn. | Bark | Ferrous sulphate |
| Rofblamala | <i>Loranthus pentapetalus</i> Roxb. | Leaf | Ferrous sulphate |
| Custard apple | <i>Anona reticulata</i> L. | Fruit | – |
| Harda | <i>Terminalia chebula</i> Retz. | Fruit | Ferrous sulphate |
| Orange dye | | | |
| Annota | <i>Bixa orellena</i> L. | Seed | Alum |
| Dhalia | <i>Dhalia</i> sp. | Flower | Alum |
| Lily | <i>Convallaria majalis</i> L. | Leaf | Ferrous sulphate |
| Nettles | <i>Urtica dioica</i> L. | Leaf | Alum |

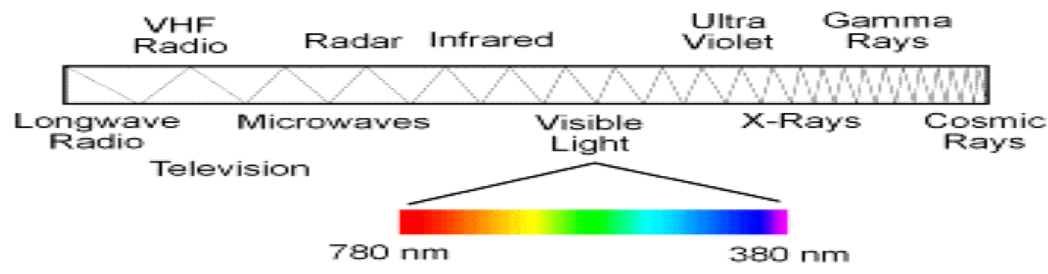
Jenis obat bantu dalam proses pencelupan

| Description | Composition | Function | Processing step |
|---------------------------------|---|--|---|
| salts | Sodium chloride sodium sulphate | Neutralize zeta potential of the fiber, retarder | Dyeing |
| Acids | Acetic acid Sulfuric acid | pH control | Preparation, dyeing, finishing |
| Bases | Sodium hydroxide sodium carbonate | pH control | Preparation, dyeing, finishing |
| Buffers | Phosphate | pH control | Dyeing |
| Sequestering agents Chelates | EDTA | Complex hardness Retarder | Preparation Dyeing |
| Surface active agents | Anionic, cationic and non ionic | softeners Disperse dyes Regular dye application Wetting agents Emulsifiers | Preparation Dyeing Finishing |
| Oxidizing agents | Hydrogen peroxide Sodium nitrite | Insolubilize dyes | Dyeing |
| Reducing agents | Sodium hydrosulphite Sodium sulphide | Solubilize dyes Remove unreacted dyes | Dyeing |
| Carriers | Phenyl phenols Chlorinated benzenes | Enhance absorption | Dyeing |

Contoh salah satu merk zat warna tekstil

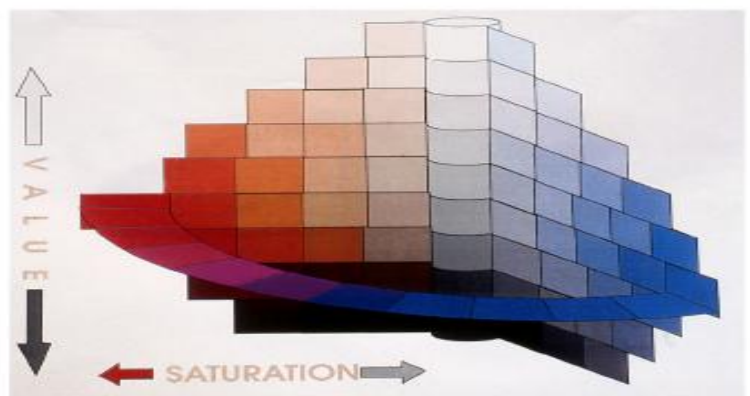
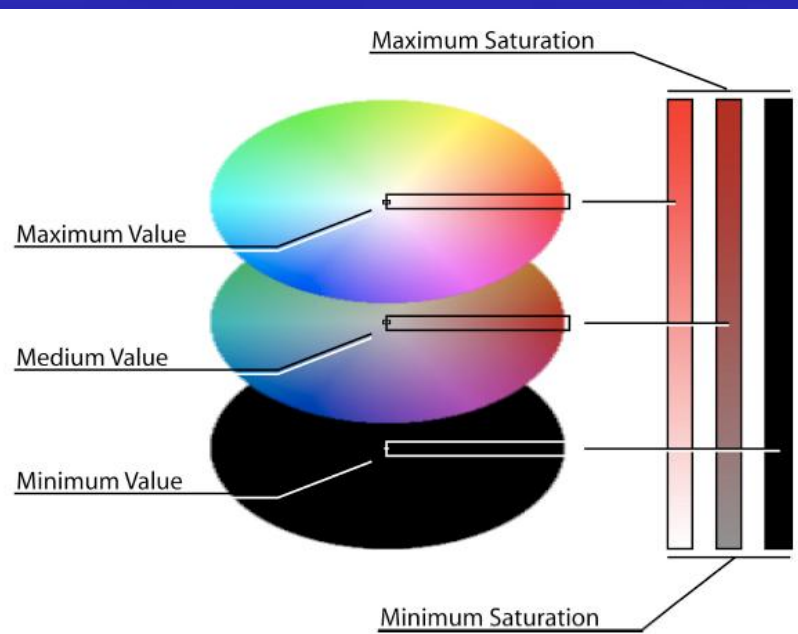
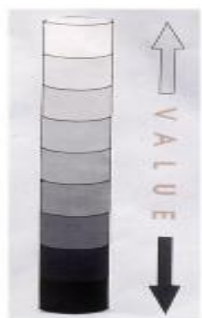


Mendefinisikan warna

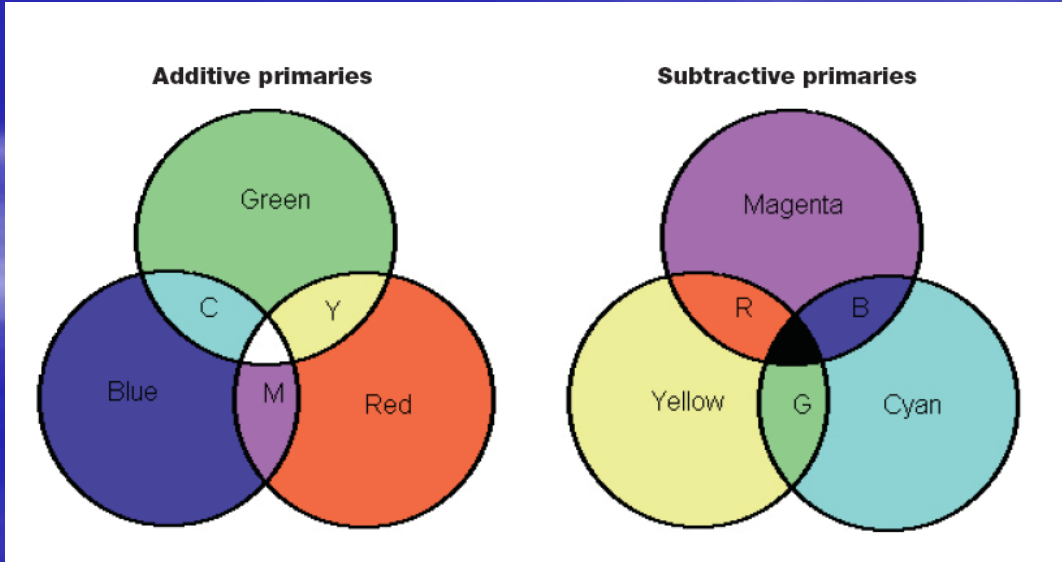
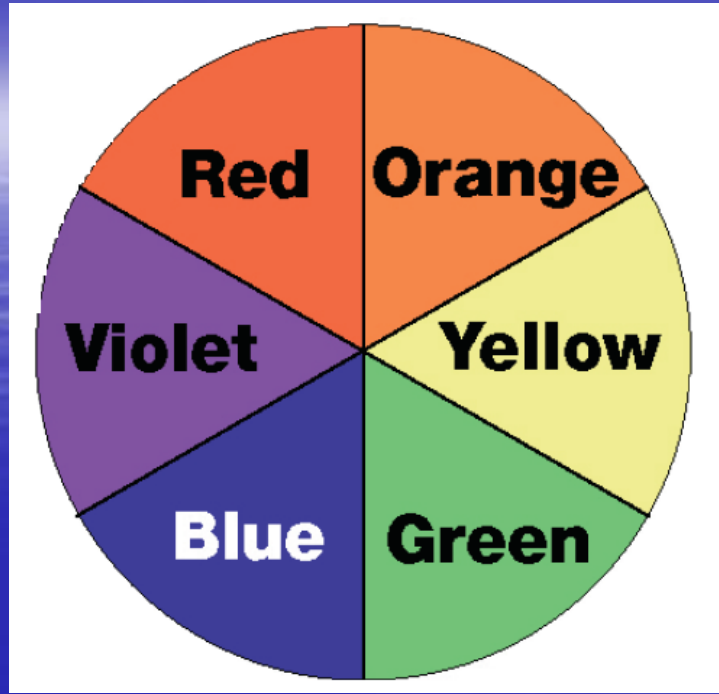


| Wavelength [nm] | Color |
|-----------------|---------------------------|
| 350 - 400 | ultraviolet (not visible) |
| 400 - 435 | violet |
| 435 - 480 | blue |
| 480 - 490 | green-blue |
| 490 - 500 | blue-green |
| 500 - 560 | green |
| 560 - 580 | yellow-green |
| 580 - 595 | yellow |
| 595 - 605 | orange |
| 605 - 750 | red |
| 750 - 800 | infrared (not visible) |

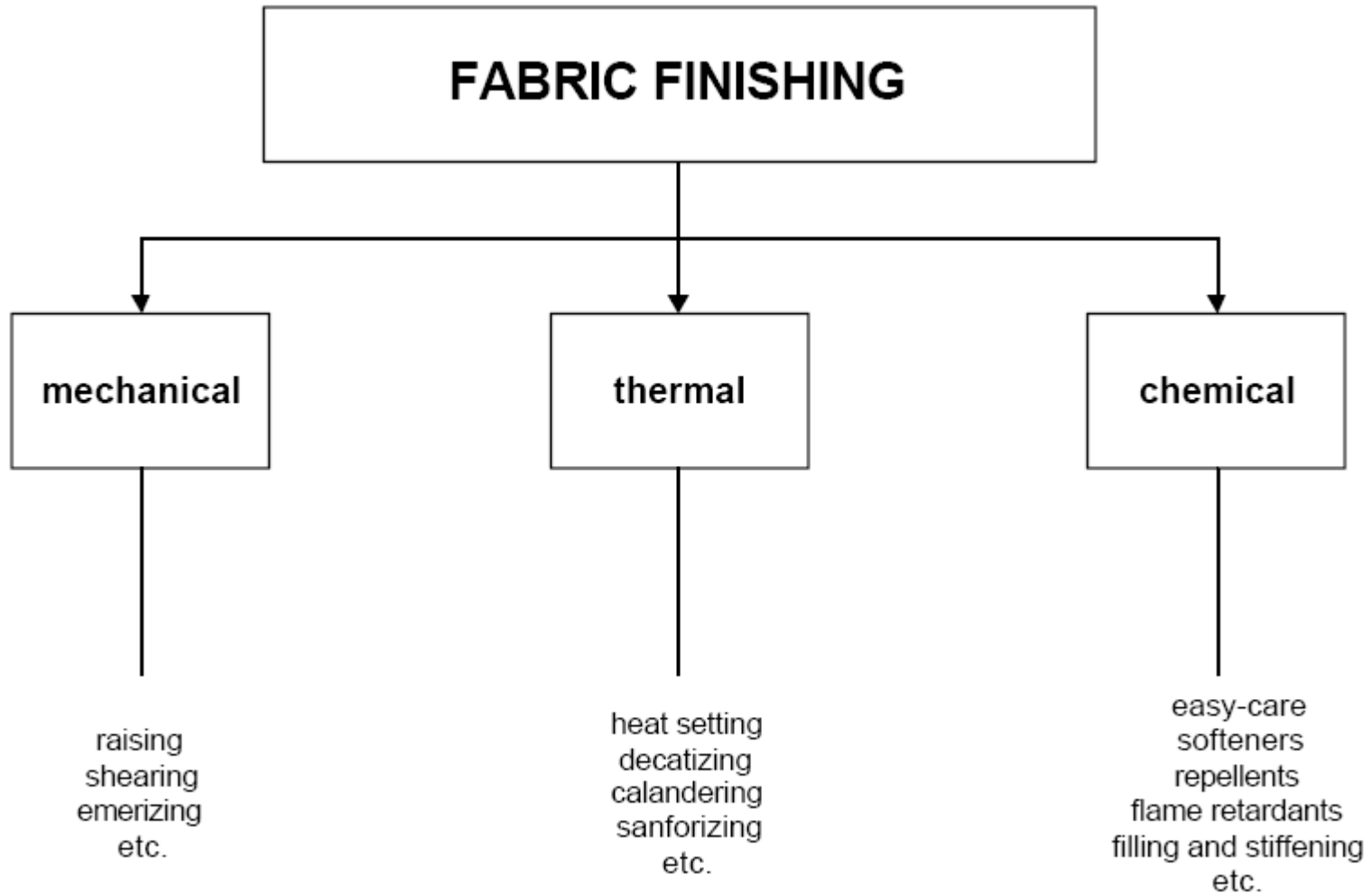
Value: light vs. dark
Hue: color vs. its opposite
Saturation: neutralized color vs. pure color



Lingkaran warna



Proses penyempurnaan akhir





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