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Preparation before wet processing

Introduction: After the gray fabrics have been received in the gray room by the finishing enterprises. the bales are opened and inspected a process which is increasingly mechanical but much of it remains subjective. The major objective is to obtain fabrics free from the exterior impurities in order to achieve smooth and trouble free results in subsequent finishing process.

Inspection: It is checked whether the gray fabrics are in confirmity with standards and all weaving faults are marked out. Fabric inspection involves 3 steps:

Perching: Its a visual inspection and the name derived from the frame called perch of frosted glass with lights behind and above it. The flaws, stains or spots, yarn knots and other imperfection are marked.

Burling: It is the removal of yarn knots or other imperfections from the fabric.

Mending: It is obviously, the actual repair of imperfections. Knotting should be done carefully and throughly so that repair or holes is not visible

Sewing: After the goods have been inspected checked and classed in the gray room, according to quality and stamped; they are sewn together end to end by sewing machines especially constructed for this purpose

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Mechanical cleaning of fabrics:

The precleaning of gray fabrics may be carried out in a seperate unit just before shearing and cropping operations. The efficiency of the precleaning is the foundation of good cropping and shearing. The pre cleaning operation is achieved with:-

(01) Through grinding of the cloth surface by energy covered rollers.

(02) Scraping with suitable designed and located scraping blades.

(03) Efficient brushing of both sides of cloth.

Brushing: The purpase of brushing is to remove the short and loose fibres from the surface of the cloth. It also removes hurt particles clinging to the cloth

Textile Wet processing

Sequence of operations:

i Preparatory

Gray fabric Inspection

↓

Shearing and cropping

↓

Singeing

↓

Desizing

↓

Scouring

↓ ↓

Bleaching mercerisation

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ii Dyeing:

water Soluble	water Insoluble
1. Direct	1 Vat
2. Acid	2. Napthol
3. Basic	3. Sulphur
4. Reactive	4. Disperse
5. Mordant	5. Azoic
6. Soluble vat	
7. Metal complex	

iii Printing

↓

Hand block

↓

Semi-automatic Screen

↓

Transfer

↓

Digital

iv. Finishing

↓

1 Calendering
2. ~~Ant~~ Anti creasing
3. Water proof
4. Water repellent
5. Flame proof
6. others

Chemical processing:

All the raw textile materials, irrespective of the form in which they are available require to be prepared, if they are to be subjected to chemical processing such as dyeing, printing, etc. Raw textiles need to be prepared as the textile fibres they consists of ~~contain~~ of contain matter that is regarded as impurity in the sense that its presence is undesirable for the chemical proces. The natural fibres contain impurities of natural origin. Monmade fibres too contain added matter, especially chemicals that are trouble free procuring. Textile materials in this

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raw state that are to be cleaned and finished are called gray fo textiles i.e gray yarn or gray fabric

Chemical treatments that enable the textile chemist to make gray the textile material absorbant are called preparatory process. with reference to cotton textiles, processes such as desizing scouring and bleaching come under this catagory; Sometimes the process of the mercerisation too is included as one of the preparatory process, through the purpose and effects of this purpose of mercerising are entirely different.

Shearing and cropping:

It is a process of removal of short fibres and loosely held yarns/threads on surface of fabric by using shearing cylinder and social blades. this will improve surface appearence of fabric

Singeing:

Main object of singeing is to remove short, hair fibres which are prodruding from surface of fabric to impart clean and smooth surface of fabric

This process is very exential from point of view in printing and finishing.

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Desizing:

Its process of removal of starch present in fabric and to prepare it for next process of scouring

Certain desizing agents such as HCL or enzymes are utilized for this purpose of desizing

Scouring:

This is very important process in wet processing Its a process of removal of natural and added impurities present in the fabric; Natural impurities in the form of oils, fats, dust, soily substances etc. are removed in this process

Scouring agents such as caustic soda (NaOH) Sodium carbonate (Na_2CO_3). Scouring can be done using enzymes

Bleaching:

Process of improving whiteness of cotton goods. It is also done for other cellulosic and protein fabrics. For this purpose oxidising and reducing agents are used

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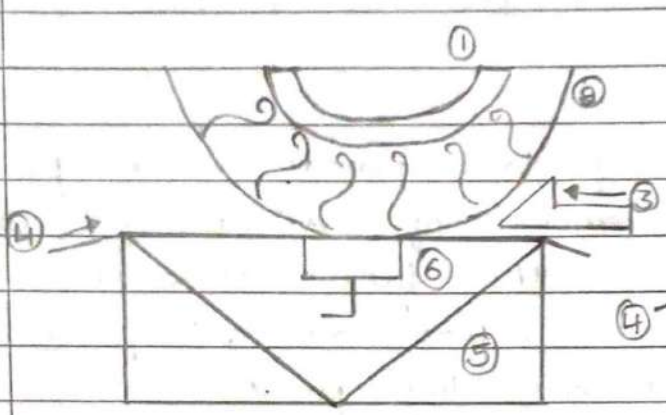
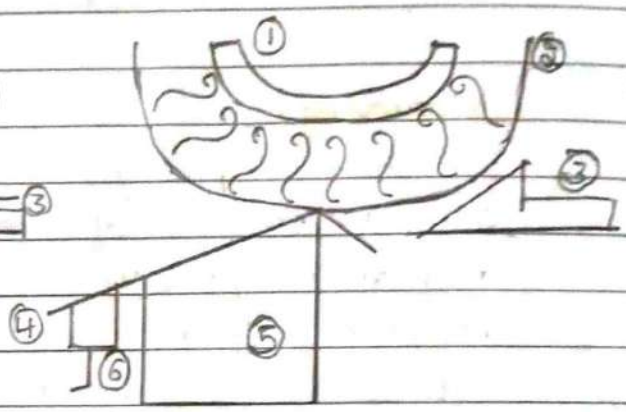
Fabric shearing and cropping.

Shearing machine with hallow table



Shearing machine with pointed table



1. Shearing cylinder
2. Spiral blades
3. Ledger blade
4. Fabric
5. Shearing table
6. Seam joint sensors

After inspection and mending, small projected yarn may ~~remain~~ remain surface of fabrics which abstruct penetration of dyes during dyeing and printing process

They may also be eatangled with the machine parts causing damage of materials. These projected yarns are removed by process like shearing and cropping during which projected fibres or yarns are cut from the fabric surface

In the shearing operation, ~~the~~ dry fabric is drown between shearing bed or table and Shearing device which consists of a shearing cylinder and table. Action is similar to that of lawn process

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Figure shows the simplified diagram of shearing machine. Shearing cylinder ①, generally consists of thick walled hollowed surface with bearing firmly inserted at both ends

Cylinders should not be unbalanced / eccentric during running. Speed of cylinder during shearing is between ~~5000~~ 500 - 2000 rpm depending on fabric

Depending upon particular design, the cylinder consists of 10-24 or upto 40 spiral plates mounted securely around its circumference These spirals are made with different profiles having homes names like knee, concave, cleaning etc--.

They have different cutting or wedge angles, cutting angles running parallel to cylinder have obtuse ($>90°$) while those running in straight line diagonally in cylinder axis have acute ($<90°$)

when ledger plate is 10-12 cm wide knife blade, 3-6 mm thick and corresponding in length to width of shearing machine

Cutting angles of blades should be small in order to obtain cleanest more possible shear. Shearing table may be hallow or pointed.

Seams must not be allowed to pass under shearing device, else they will cut open the seam joint sensors are situated to raise the ~~fabric~~ cylinder away from the fabric surface or to lower the shearing bed whenever the seam joint reaches shearing point.

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In some of the machines, the rotating brushes are installed infront as well as behind shearing device to raise fibres correctly for shearing and to remove cut ends after the shearing respectively

Singeing :

Objects of singeing:

Singeing is the proces of burning off of the ~~prod~~ protruding fibres from the surface of yarn or fabric in order to improve lustre and ~~contributes to a dull~~ appearence of the smoothness of material. the fuzz at the protruding fibres are called, tends to scatter light incident on the yarn and contributes to a dull appearence of the textile material. Removal of fuzz result in smoother and more uniform surface that reflects more light and therefore brighter appearence

Reasons for Singeing:

* Singeing improves the end wearing properties of textiles.
* The burning off of the protruding fibres results in a clean surface which allows the surface of fabric more clear
* Singeing reduces the fogginess caused by the deffering reflection of light by the projecting fibre and dyed fabrics appear brighter

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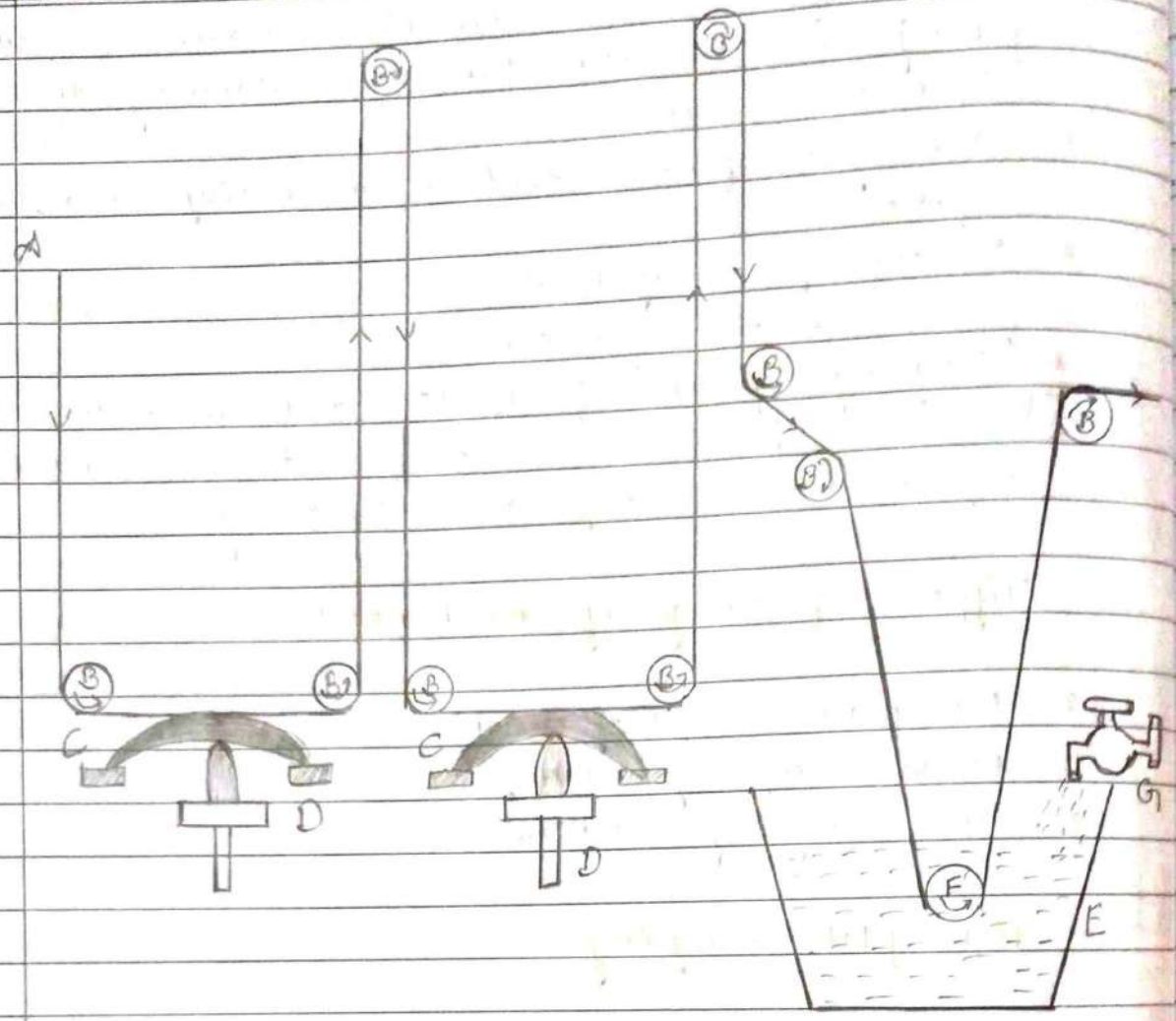
* Singeing is an effective means of reducing pilling in blended fabrics containing the synthetic fibres
* Unsinged fabrics soil more easily than singed fabrics
* A closely singed fabric is exential for pirnting fine intricate patterns
* Singeing process facilitates and speeds up desizing if the fabric is impregnated with desizing liquor immediately after singeing

Types of Singeing machines:

1. Hot plate singeing machine
2. Roller singeing machine
3. Gas singeing machine

Hot plate singeing:

This machine consists exentially of two or more curved copper plates that are kept red hot by means of the heating arrongement under them as ~~it~~ it is shown in figure, The cloth to be singed is paved with the acid of guide rollers over the hot plates heated by burners such that the fabric and hot plates are in continuous contact with each other. An automatic traverse motion is fitted to the machine so that the plates change their surface of the contact with the cloth as it moves continuously After paving the last hot plate. the cloth is immediately paved through a water filled trough into which cold water ~~fetted~~ is filled. continuously flowing from inlet tap. This quenching is to contract any tendency of the hot cloth to catch fire



Advantages:

Suitable for back filling finishing process as the fibre ends in the intersects are not removed

Disadvantages:

* Fibre ends in the intersects of warp and weft are not singed
* Produced on undesirable fabric lusture due to frictional contact with hot plate
* Causes uneven singeing due to difficulty in maintaining uniform plate temperature

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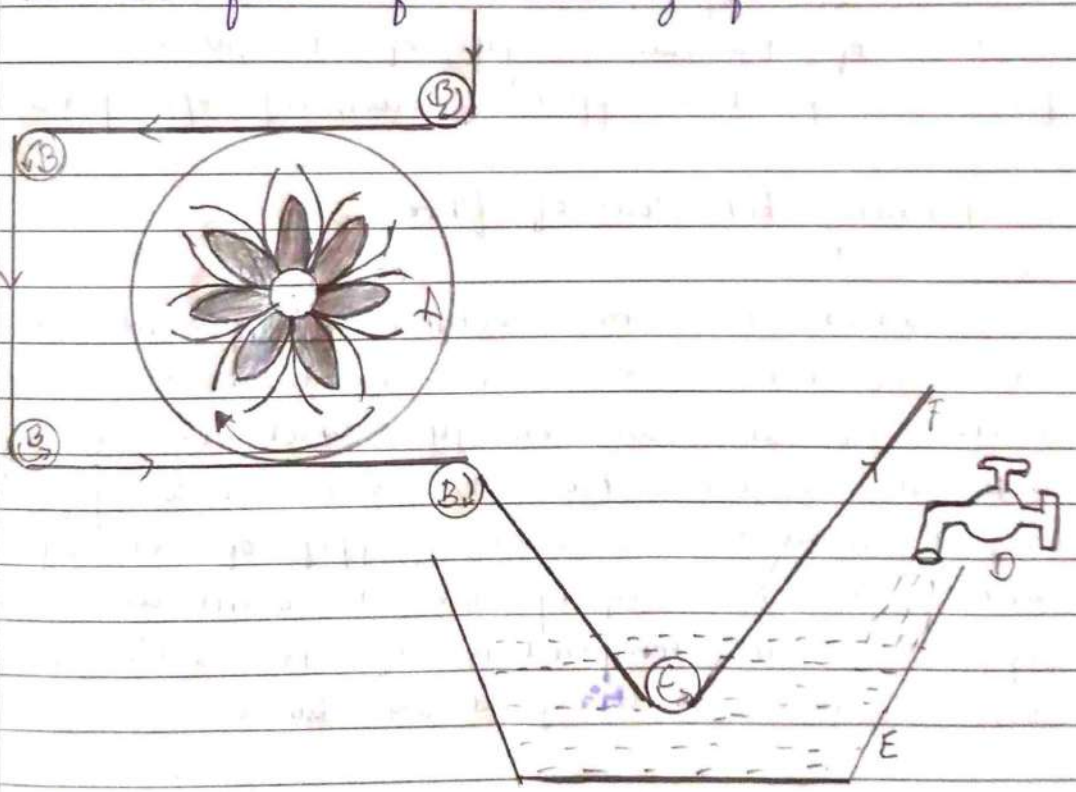
Roller Singeing

Roller singeing is similar to hot plate singeing. Here instead of hot plate a large cylindor or roller is used. The inside of cylinder is heated to maintain its outer surface very hot, The cloth to be singed passes around a guide roller and then over that heated cylinder touching its top. It then goes around two more guide rollers to pass under the cylinder touching its bottom. The guide rollers also serve to keep the fabric under adequate tension.

In roller singeing too, the cloth is immediate-ly passed into a trough of cold water to prevent the hot fabric from catching fire



Advantages and disadvantages are some as that of ~~th~~ hot plate p singeing except that uneven Singeing takes place to a lesser extent

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Gas Singeing:

Fundametals of gas Singeing

The main purpose of singeing is to burn the protruding fibres from the surface of yarn or fabric Inorder to ~~eleaning~~, burn the protruding fibres, energy must to be supplied, The supplied energy must be just enough to burn only the protruding fibres, while keeping the firmly bounded fibres in tact. This is acheived by allowing the time of contact between the singeing flame and fabric to practically a fraction of seconds. As the temperature of the flame is too high around 1300°c any relulation of this temperat -ure is out of question. however, metering and control of thermal energy of the flame is essential for the safe but effective burning off proces

Burning behaviour of fibres

Cotton has an exothermic pyrolysis as once it has been ignited it continues to burn by virtue of its own energy which is being releared, Polyester has an endothermic pyrolysis as it requires a steady supply of energy to allow the burning proces to continue. polyester ignites at a temperature of 480° - 500°c while it starts melting at 258 - 260° c

For the singeing of polyester fabric or yarns, thermal energy must be supplied in a shock form and the pyrolysis must be like an explosion so that the polyster protruding fibres ignite & rather than melting otherwise the molten beads of Polyster may be formed

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Gas singeing machine

A gas singeing machine consists essentially of one or more burners that are designed to produce a continuous, uniform flame by burning a mixture of compressed air and coal or natural gas. The flame issues from a narrow slit which is adjusted with respect to its width and thickness.

When the cloth is drawn over the flame at high speed, the flame impinges on its surface and burns the protruding fibres without damaging the cloth. The speed of transmission of the cloth through the singeing machine has to be adjusted to suit the amount of the singeing required. without the risk of burning the cloth. The flame is adjusted to be long enough to ensure that ~~to be long enough~~ to when it impinges on the cloth surface, the fibre ends present on the interstices of the warp and weft threads are also singed.

After singeing the cloth is passed into a trough of water and then through the nip of two roll water mangle to quench the fabric and extinguish any sparks, of fire or glowing fibre ends. Alternatively the surface of the cloth is hit by a sharp spray of water. The typical arrangement using a four burners gas singeing machine is as shown in the figure

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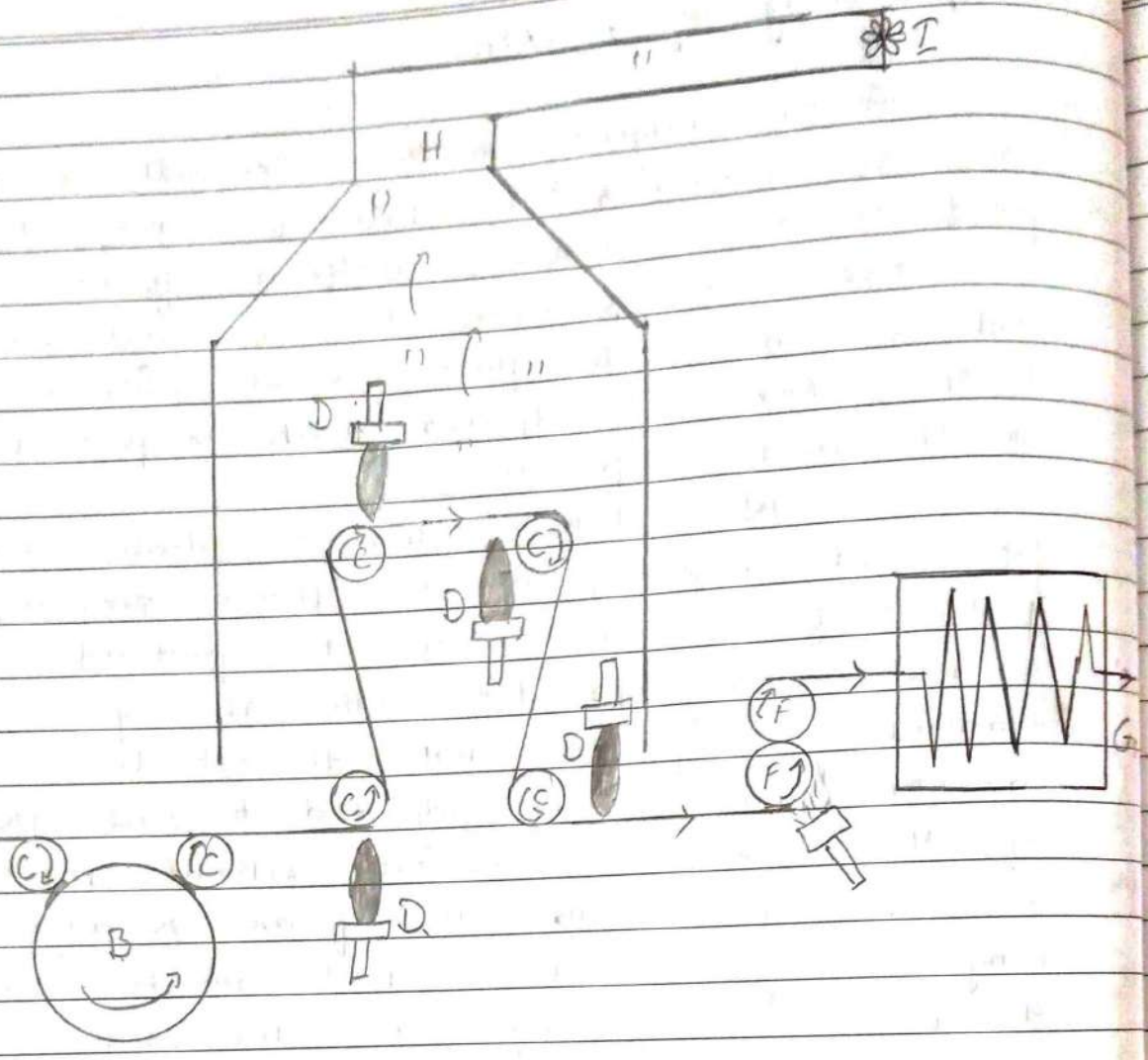

Advantages!

* Both sides of the cloth are singed simultaneously
* Uniform singeing of the cloth is obtained
* No chances of cloth sheen, as in the case of roller and plate singeing machine because there is no contact with metal surface
* Singeing can also take place between the intersecties in warp and weft
* The flame can be controlled, so as to be equal to the width of the cloth being singed
* Machine speed can be high and in the range of 80-125 m/min
* Different varities of cloth can be conveniently easily singed

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Disadvantages:

Major disadvantage is risk of fire if proper care is not taken, this problem can be completely avoided.

- The flame is adjusted to optimum size
- Careful monitoring of the singeing process
- Operators has to be trained to run the singeing machine properly

Precautions:

* Supply of gas to the burners should cut off if for any reason the fabric fails to move
* Hood and exhaust fan to be provided on the top to remove the burnt fibres and exhaust gas
* The fabric taken for singeing should be dry.
* Thermo couple arrangement should be ~~dr~~ provided to ~~measure~~ measure the temperature of fabric
* Singeing machine should be provided with automa -tic fabric threading and speed ~~mon~~ moistoning device

Note: Rate of combustion of some fibres is greater than that of other Ex: The combustion of cellulose fibres is considerably quicker than that of protien fibres. Suitable adjustment must be made to the flame size and machine speed for the inflammable fibres

Important consideration during Gas singeing:

- Make sure that the flame is more bluish (less yellowish) to give the maximum temperature
- Control and maintain the recommended flame length and angle of contact, depending on the fabric construction, thickness, heat sensitivity, etc--

- Regulate the fabric speed according to the fabric construction, thickness, weight, etc.
- Make sure that all the burner nozzles are free from choking, choking of nozzles may result in the haziness appearence, patchy appearence or front lines, which become apparent after dyeing.
- Make sure that the machine is threaded through the machine correctly. Rubbing marks may show up if the fabric is threaded wrongly over defective ~~stent~~ stationary bars or if the fabric rubs against the burners (As the guide rollers are very close to the burners, any problems due to the ~~burners~~ loose brackets supporting the rollers will guide the fabric to touch the burners (nozzle). Invariable such defects only show up after dyeing or finishing, at which stage it is difficult to attribute the cause to the singeing machine operation.
- Make sure that the machine is threaded as per specification drawing so that both sides of the fabric ~~w may result in~~ face are singed. Singeing on only one side of the fabric may result in face to back shade variation after dyeing.
- Make sure that the width of the flame is set to cover just a little more than the fabric width, to conserve energy
- Make sure that the exhaust blowers over the burners are in proper operation. If not, it can lead to redeposition of the burnt out fibres on the fabric causing black specks.

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- Ensure proper quenching into water / desize both after singeing. otherwise, the entrapped smouldering particles may lead to fabric getting burnt (hole)
- Guide rolls next to the flames or the guide rollers on which flame is directed in case of heat sensitive fabrics should be cooled, generally by cold water circulating through the guide rollers, otherwise they could become red hot and scorch the singeing fabric
- Interlinking of the button / flame switch off mechanism or quenching system should be effective to avoid burning of the fabric and any incident of fire.

Important Gas singeing parameters.

1. Flame Intensity: Together with the supply and control units for gas-air mixture, burners comprise the most important part of any singeing machine. The flame intensity of the singeing burners is based on the amount and the outlet speed of the gas-air mixture leaving the burner slots. Besides having high thermal energy, flame also has considerable mechanical energy. All the thermal and mechanical energy of the flame is directed ~~on~~ onto the fabric during singeing. The temperature of the flame at mouth of burner is in range 1250 to 1300°C, the speed of flame at burner outlet may be between 15 and 35 m/sec. The flame intensity usually lies between 5 and 20 mbars

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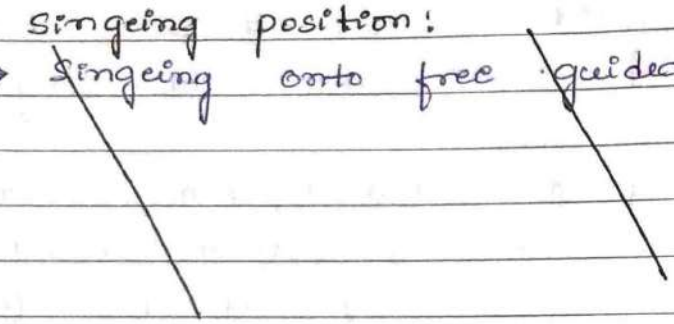
2. Fabric speed : The fabric speed in the singeing machine is usually in the range of 50 – 160 m/min depending on fabric b (gram per square meter) weight and fibre blend. For behaviour fabrics the speed is kept slower as compared to lighter weight fabrics.

3. Singeing position :

→ Singeing onto free guided roller



- This is the most intensive singeing position with highest efficiency. In this position, the flame make sure that the exhaust blowers over the burners are in proper operation. If not, it can lead to redeposition of the burt out fabric causing black specks
- Ensure proper quenching into water / desize bath after singeing. Otherwise, the entrapped smouldering particles may lead to fabric getting burnt (hole)
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- Interlinking of the button / flame, switch off mechanism or quenching system should be effective to avoid burning of the fabric and any incident of fire.

~~Important gas singeing parameter~~

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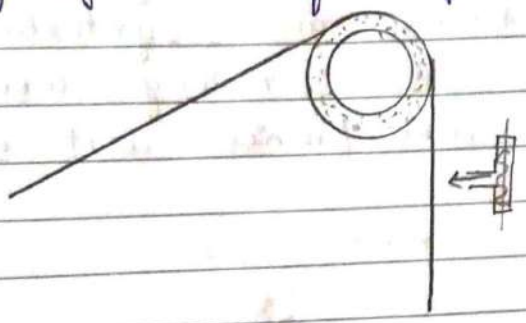
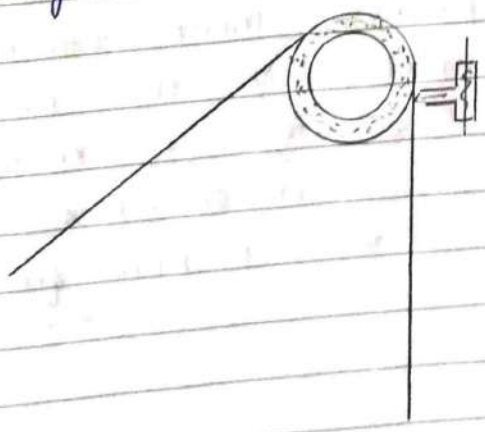
3. Singeing position :

→ Singeing onto free guide roller



This is the most intensive singeing position with highest efficiency. In the position, the flame onto the free guided fabric at right angles. This position is usually recommended for the singeing of fabrics with all natural fibres, regenerated fibres, and blended fibres, which have been tightly woven and have weights over 125 gm/m^2

→ Singeing onto water-cooled roller



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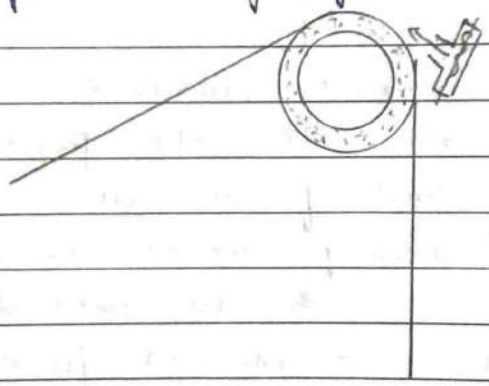
In this position, the flame bounces at right angles onto fabric while the fabric passes onto water cooled guide roller. This position avoids the penetration of the flame into the fabric The flame does not pass through the fabric and because of the fabric passing onto water cooled roller, any thermal damage of temperature sensitive synthetic fabrics is then avoided. This position is usually recommended for all blended and synthetic fabrics as well as for fabrics having weights lesser than 125 gm/m² and fabrics with open structure

→ Tangential Singeing:



In this position the singeing flame falls on the fabric tangentially. The flame touches only the protruding fibres without having any kind of significant contact with the main fabric body This position is usually recommended for very light weight and sensitive fabrics as well as fabrics with broken filaments

4. Distance between flame burners and fabric:

As the energy content of the flame is lower than farther it is form the burner, the singeing efficiency consequently decreased by increasing the burner-fabric distance. The distance between the burner and the fabric is usually in the range of 6-8 mm but it can be adjusted in the range from 6-20 mm.

5. Flame width:

All good singeing machines come with a provision of flame width adjustment according to width of fabric. This is essential to optimize the gas economy

Novel singeing method :- (Indirect singeing)

Various problems are associated with the direct singeing methods (Gas singeing.) problems like:

- Uneven flame heights
- clogged flame jets
- Slacks and wavy selvedges
- Uneven surfaces
- Creases and surface flaws in fabric
- Reduced tearing strength.

In the novel singeing method, hot radiation from ceramic heat retention zone burns away the fibre protrusions. The heat is in the form of diffused more even singeing effects than those described above can be used for fabric having wavy selvedges

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Fabrics normally singed.

- Shirting and suiting material
- Sarees, dress wear fabrics
- Voile cloths, poplins, polyester, cotton

Yarn singeing:

yarns meant for knitting or for sewing threads is also be singed. The singeing in this case is called Gassing, and the ~~Sign~~ Singed yarn is called gassed yarn.

yarns that are typically singed are:

- Combed cotton yarn
- Highly twisted voile thread
- Sewing thread
- Polyester cotton blended yarn
- Hosiery yarn for knitting

Singeing faults:

→ Uneven singeing effect can cause streaks when the fabric is dyed or bubbles when the fabric is finished

→ In the cotton system singeing is done on the grey cloth, but for fabrics blended containing Synthetic fibres grey state singeing is not advisable because small globules of ~~meth~~ melted synthetic fibres absorb dye preferentially giving cloth a speckled appearence

→ There is a possibility of thermal damage to the temeprature sensitive fibres, for instance polyster

→ stop off can cause heat bars on the fabrics. Creasing produces streaks which is magnified when dyed

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→ Protruding fibres are ~~fine~~ firmly bound by the singeing on surface by the sizing by the hardening of the size and can be lead to difficulties in desizing.

→ When singeing is done after desizing and dyeing, heat can cause color loss from polyester portion of blend because of the sublimation of dye.

→ There may be reduction of tearing strength due to oversingeing of fabric

Testing of singeing Effectiveness: (Efficiency)

The singeing efficiency can be checked by one or more of the following tests.

→ By looking at singed fabric with the magnifying glass and comparing its hairiness with that of unsinged fabric

→ By testing singed fabric for pilling performance and comparing with that of the unsinged fabric. A well singed fabric shows less pilling

→ By sticking and removing a sticking tape on singed fabric and observing number of fibres attached to sticking side of tape, well singed fabric results in less number of fibres

→ Noticing the feel or handle of singed fabric An over singed fabric may be give harsher feeling

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Cleaning, Cropping and Shearing:

Various impurities like cotton seed husks, seed coats, sand, dust, fluff, linters, size and others artificial substances which are unavoidably introduced during fabric making The unwanted impurities must be removed from the fabric before the wet processing This is carried out in two steps:

Pre-cleaning process: In this step, the fabric is made ready for the cropping and shearing operation using a suitable combinatio of rollers covered with the brush spirals

Cropping and shearing! This process involves the cutting of loose threads hanging from the body of the fabric and the selvedges by means of pair of blades arranged at a specific angle, relative to each other

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DESIZING

Introduction:

Gray Cotton fabric containing natural impurities and as well as size added to the gray fabric in a weaving preparatory process called sizing. The removal of size from the fabric by a process called the desizing process

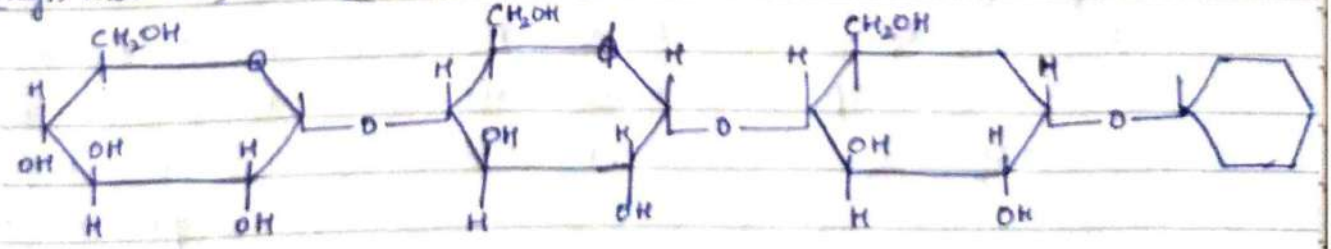
Sizing ingradients like starch, thin boiling starch, carboxyl methyl cellulose (CMC), Polyvinyl alcohol, vegetable oil, mutton tallow, etc. This sizing process is carried out to improve the strength of the yarn but ~~make~~ makes fabric ~~unstable~~ unsuitable for dyeing. Although the sizing of warp is a necessary operation to the weaver, the size in the gray fabric is hinderence to the chemical processes. Hence this unwonted size has to be removed for succesful wet processing. Starch its chemical name is poly α-gluco pyranose. which contain (1) Amylose - Straight chain polymer

(2) Amylopectin - Branched chain polymer

Both are insoluble in water

$$(C_6H_{12}O_5)_n \longrightarrow (C_6H_{12}O_5)_x \longrightarrow (C_{12}H_{22}O_{11}) \rightarrow (C_6H_{12}O_6)$$

Starch (high mol wt) — Dextrin (low mol wt) — maltose — Glucose



Amylose – Straight chain polymer

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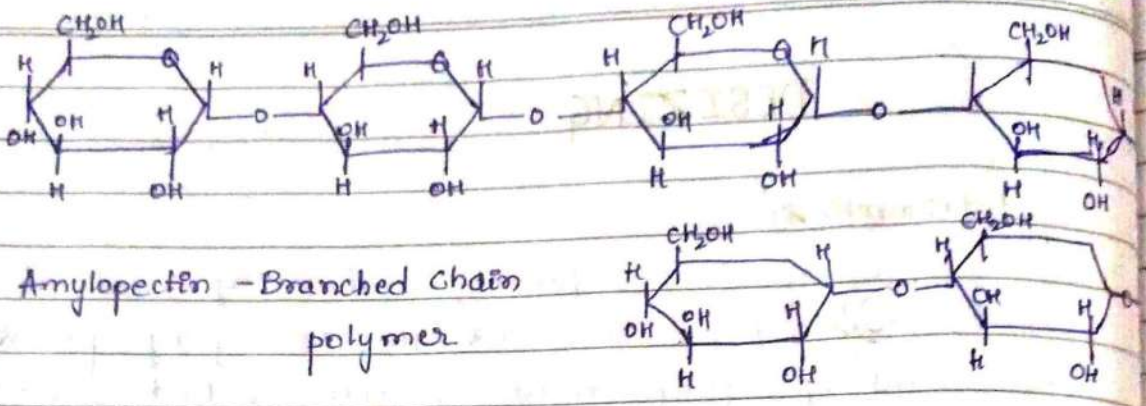

Amylopectin - Branched chain polymer.

object of Desizing :

It is to remove the size that is applied to the gray fabric and makes the fabric free of the added matter and can be effectively scoured and bleached

Desizing is a chemical process and can be controlled. Ex: If desizing liquor is strong the process will be fast and completed in a short time and the process can be continuous If the solution is weak the process will be taking longer time and the desizing would be necessarily be a batch process

Desizing methods.

Hydrolytic methods	Oxidative methods	Novel methods
1 Rot Steep	1 Chlorine	1 Solvent
2. Acid Steep	2. Chlorite	2 Desizing 2000
3. Enzymatic	3. Bromite	3. low temperature plazma treatment

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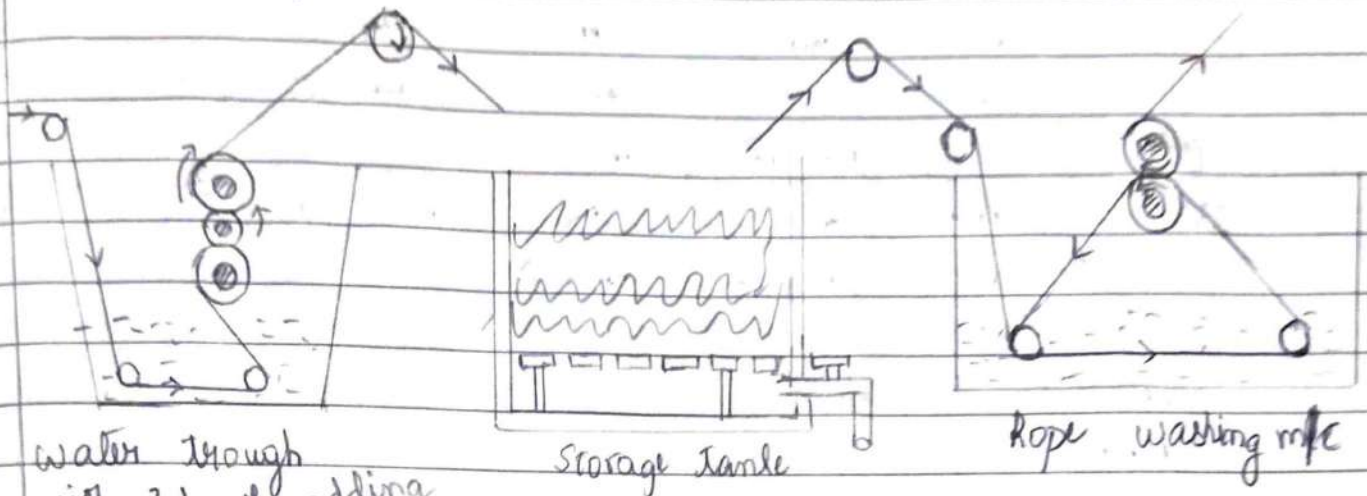
Rot Steep method :-



Water trough with 3 bowl padding

Rope washing m/c

→ Oldest and cheapest method
→ No special chemical is used
→ Cloth is immersed in worm water at 40°C and them immediately paseed through padding mangle to give 100%
→ Mangle pressure is adjusted that the cloth is squeezed to retain 100% of its weight of water
→ Then the cloth is piled up in a tank & allowed to stand for 24 hours
→ Microorganism present in the water multiply and secrete starch, liquifying enzymes which will hydrolyse the starch
→ Then the cloth is finally washed with water

Advantages :
→ Most economical method.
→ It requires no chemicals

Disadvantages :
- This procss requires large floor space
- slow procss, requires several hours
- There is danger of mildew attacking and weakening the cloth, if the steping is not properly monitored

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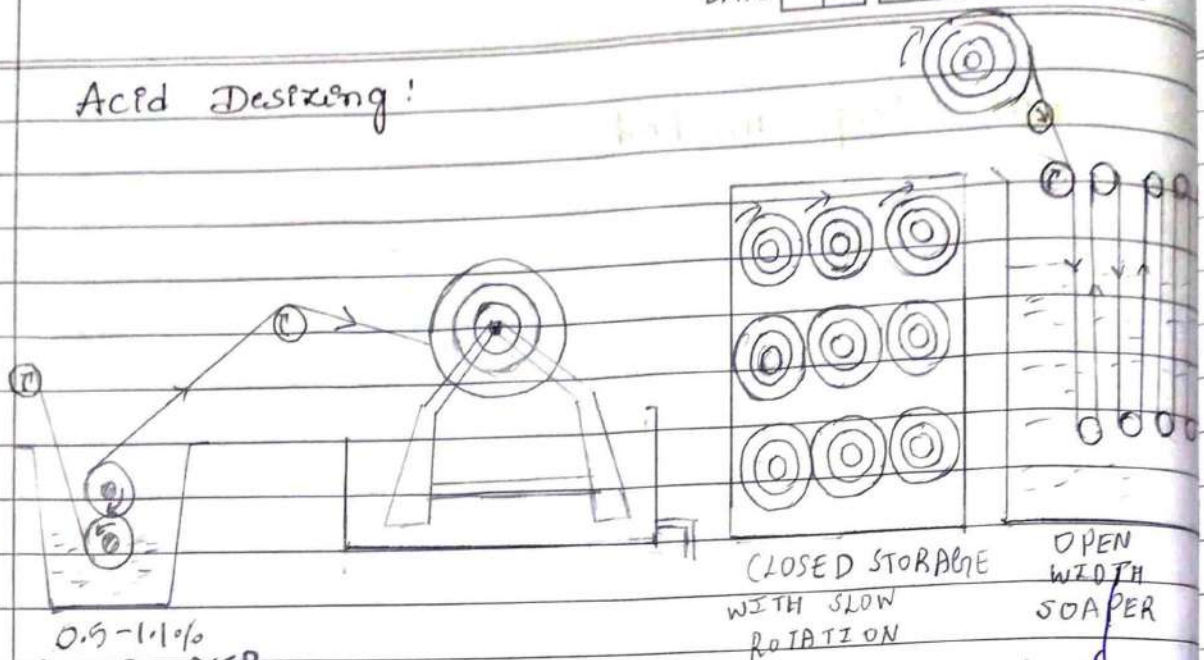
Acid Desizing:



Acid desizing involves the use of dilute H_2SO_4 or hydro chloric acid (HCL). The acid hydrolysis the starch present in the sized fabric, Atleast 0.2 % (w/v) solution of acid. i.e containing 0.2 kg of acid for every 100 lbs of solution at room temperature (30°c). is sufficient for this procss. The cloth is sufficient for impregnated with the delute solution in a two-bowl padding or three bowl padding mangle as shown in figure

The acid impregnated fabric is then squeezed evenly in the mangle and is batched wet on a soluble roller. The wet roll is covered with polyethylene film and kept aside in a room with the roll rotating slowly, so that it remains uniformly wet during the desizing action. The roll will be stored for nearly 1-2 hours depending on the type of fabric and the amount of size in it, Then the fabric is washed in open width till it is free from acid products of hydrolysis of the size ingredients.

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Recipe:

Mineral acid - 0.5 to 1%

Temperature - 30°C

Advantages:

- The process is economical
- It is quicker than rot steeping
- It does not require specific conditions of temperature, and pH and can be done at room temperature

Disadvantages:

The major disadvantage of the process is that care must be taken to prevent tendering of the fabric

Enzymatic Desizing:

Enzymes are high molecular weight substances or proteins and are biocatalysts, and they are also bio-degradable, and biocompatable and highly ecofriendly in nature

Classification:

There are two kinds of desizing enzymes

- one type derived from animal source.
- And another type from vegetable source

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Animal Source

Ex: 1 Viveral
2 Novo formosal
3 Degomma
4 Slaughter house waste
like poncreal,
clotted blood, liver etc.

Vegetable source

malt extract	Bacterial extract
Ex: Diastafose	Ex: Raddase
Diastae	Bid lase
Malstostase	Taka
	Arey

The outstanding feature of the process is the specific nature of the action of enzymes which are active only under certain conditions of the concentration, pH, and temperature.

Enzymes	Concentration (g/L)	Temperature	pH
malt extracts	3 - 20	50° - 60°C	6 - 7.5
Poncreatic	1 - 3	50° - 60°C	6.5 - 7.5
Bacterial	0.5 - 1	60° - 70°	5.5 - 7.5

Enzymes suffer from the disadvantage that if the conditions of temperature and pH are not maintained, little or no desizing takes place

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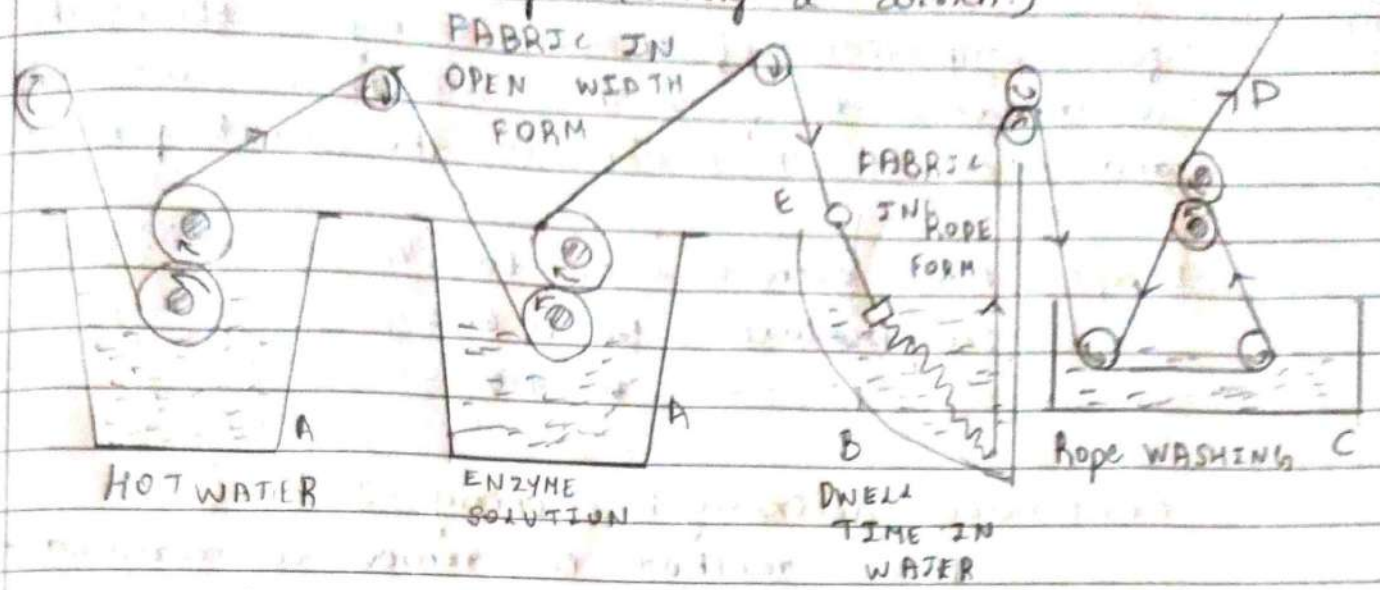
Continuous Desizing:- (using a winch)



A - Padding mangles B - winch machine
C - Rope washing machine D - Desized fabric
E - Pot hole

The grey fabric is first padded through hot water and then through 0.5-2% solution of malt extract kept at 50°-60° C and pH 6-7.5. Impregnation of cloth with hot water prevents the cooling of malt extract solution. when stronger solutions are used, desizing can be achived even in five minutes and a nearly continuous process is possible

The cloth impregnated with enzyme solution of higher concentration is converted to rope form and is allowed to fall in a winch with a smooth sloping bottom. The cloth assumes a wavy shape and slides down the slope of the winch floor. The cloth takes five minutes for its travel from the end where it was dropped in the winch to the other end from where it is picked up for washing in a rope washing machine.

The speed of the winch and that of the removal of cloth from the winch is synchronized with each other to give required dwell time

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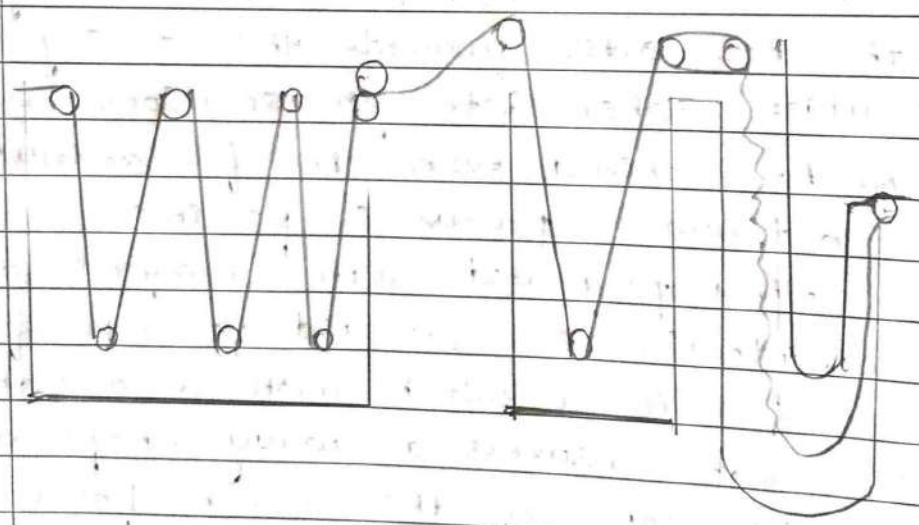
for completion of the desizing action. The cloth removed from the winch is washed and then it is taken to the next process

Recipe: Malt extract - 0.5 to 2%
Temperature - 50° to 60°C
pH - 6 to 7.5

Continuous desizing: (using J-box)

This method is ~~error~~ recommended for polyester / cotton blends. the material is padded with enzyme solution and passed through open width J-box kept at 80-90°C The speed of the fabric is such that a dwell time of 25-40 mins is obtained the material is then washed with hot and cold water in soaper



Recipe: Enzyme - 1 to 2%
Temperature - 80 to 90°C
Time - 25 to 40 mins

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Advantages:

1 The process is quick
2 As the process is continuous it gives rise to uniform desizing and the production and efficiency is high.
3 Fabric of close construction or heavy fabric can be effectively desized.
4. There is no risk of cellulose getting to be tendered in the process

Disadvantages:

1 If the specified conditions of temperature and pH are not maintained, the desizing action of enzymes does not occurs
2. Chances of desizing efficiency can destroy

Desizing of PE/C blends :- (Polyester/cotton blends)

Polyester cotton blends are very popular on account of the advantages offered individually by both the components in the blend polyester has got high strength, good extensibility, elasticity, abrasion resistance, and pleasant handle etc- and cotton on other hand contributes to the good comfort characteristics to the good comfort and pleasant handle with good moisture absorption and social morphological attributes. The polyester/cotton blends are sized using polyvinyl alcohol in addition to the usual chemicals like strach, (CMC) carboxyl methyl cellulose, fats, waxes and tallow are also added

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Semi Continuous process - The Pad roll process.

The PE/C fabric to be desized is impregnated with a solution of a desizing enzyme kept at 60°-70°C allowing atleast 4 dips in the liquor and a suitable wetting agent is used in the pad liquor. The pH of the liquor is adjusted according to the best activity of the enzyme being used and this normally 6-7 sodium chloride (NaCl) is included in the liquor to further activate the enzyme. The fabric is then padded under even pressure that permits about 100% uptake of the treatment liquor.

Recipe : Enzyme - 6 to 10 gpl.
Sodium chloride - 5 to 8 gpl.
wetting agent - 0.5 to 1.5 gpl
pH of pad liquor - 6 to 7.
Pad liquor temperature - 60° to 70°C
Storage temperature - Room temperature
Liquor uptake - 100%.

The padded fabric is then batched on a roll and it is kept rotating slowly in the chamber at ambient temperature to ensure that the roll is evenly wet while the desizing action goes on for 6-12 hours. The desized fabric is then unwound and washed on an open width soaper by using hot & cold water till all the soluble degradation products of the starch are completly removed

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Sodium carbonate desizing.

Polyester / cotton blends contain only water soluble size and in such cases enzymes treatment with is not necessary and a simpler type treatment with mild alkali such as Sodium carbonate and detergent will be sufficient. The sodium carbonate effectively removes size chemicals like water soluble cellulose ether and ether and modified starches like dextrin, other size chemicals like polyvinyl alcohol are also quickly removed on account of their water solubility

Recipe; Sodium Carbonate - 4 to 5 gpl
Detergent - 1 to 1.5 gpl.
Desizing temperature - 70° to 80°c
Time - 1 hour

After treatment: The fabric roll is washed with hot water, Soluble size can be desized, and then with cold water until the materials ~~pH~~ pH is neutral.

Sodium Bromite Desizing :- ($NaBrO_2$)

Semi continuous process - PE/C blends which contain Starch and water soluble size can also be desized by means of sodium bromite, which is an oxidising agent and can therefore rapidly oxidise starch into products that are soluble in caustic alkali.

Racipe - Sodium bromite - 1.5 to 2 gpl
Sodium carbonate - 5 to 6 gpl
wetting agent - 1.5 to 2 gpl
Temperature - Room temp^r

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The fabric is padded in the above liquor using regular padding machine with a low liquor pad bowl. The padded material is then kept aside for 10-20 mins. for the starch to get oxidised. The material is then treated at the boil in a bath containing 5-6 gpl of caustic soda in open soaper machine. The alkali treated goods are finally washed with hot and cold water.

Continuous process: The sodium bromite process has the advantage of rapid speed of the action and the results too are good. The wetting agent concentration may vary, if the fabric has a content of tallow that prevents easy wetting of the desizing liquor. The quickness of action of sodium bromite permits its use in continuous desizing process.

Recipe: Sodium bromite - 3 to 5 gpl
Caustic soda (NaOH) - 2 to 3 gpl.
Wetting agent - 1.5 to 2.5 gpl.
Temperature - Room temperature.

The padded fabric is led to a steamer for 40-60 seconds at 100°-101°C. The steamed fabric is then thoroughly washed in an open width soaper.

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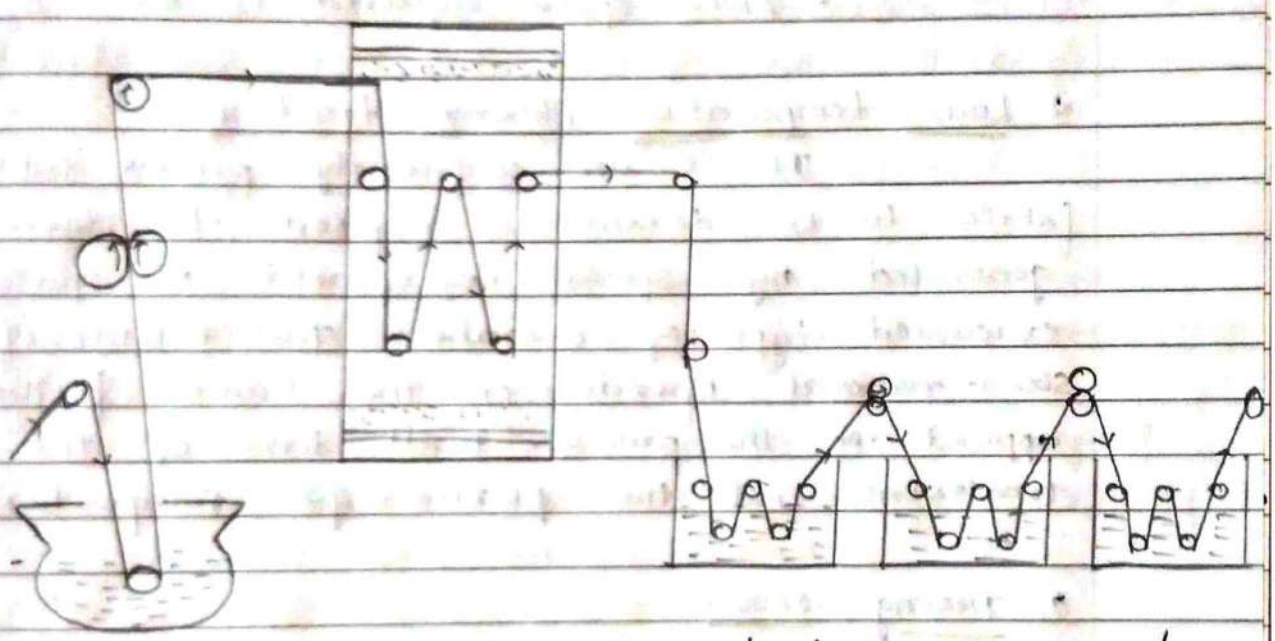
Continuous proces Using Enzyme - The Pad stream proces.

Enzymes have traditionally been used at low temperature in the range of 55°- 70°c. The temperature is characteristic of the enzymes are available that possess good stability and are active even at high temperature. Such enzymes can be used in continuous dyeing process.

In the figure shows the pad stream proces, the fabric is padded in the liquor containing high temperature



Stable enzymes are steamed for 45- 90 seconds with wet steam. The steam also dissolve with water soluble size material and then washed in an open width soap for washing off the hydrolysed starch.

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Novel desizing techniques.

1 Solvent desizing:

Desizing can also be done by using some solvents. The solvents are recoverable and hardly any or no effluend is discharged. This method gives soft and lustrous feel to synthetic fibres like acrylics

advantages - low energy consumption
- Desizing time is less
- Floor space required is less

2 Low temperature plazma treatment.

It is an ecofriendly process where a fabric to be desized is exposed to plazma generated by special equipment is specially evacuated type of chambers. The extent of size removal depends on the radio frequency applied in the process. dwell time of the treatment and the plazma-gas composition

3. Desizing 2000 -

This is simple and reliable combined desizing and demineralisation process of cotton with only three auxillaries

Ex- Beizon NE, Kollaco IMCE, and Biezol T2090, by cold batch or pad steam process.

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SCOURING

Introduction:

Scouring is almost invariably the first wet process applied to textile materials. The object is to remove oils, fats, waxes, soluble impurities and any particulate or solid dirt adhering to the fibres. The process consists essentially of treatment with a detergent with or without the addition of alkali. When soap is used a good supply of soft water is essential but this is of less importance with the synthetic detergents which now occupy such a prominent position.

Objects of scouring.

1 To remove natural as well as added impurities of essentially hydrophobic character (oils, fats, waxes .etc.) as completely as possible and leave the fabric in a highly absorptive condition without undergoing significant chemical or physical damage.

2. To make the goods suitable for removing the natural coloring matter of the cotton during the subsequent bleaching process

Scouring of cotton:

Natural cotton, unlike raw wool, contains only a comparitively small portion of impurities. The waxes, however are of high molecular weight which makes their removal difficult, and the proteins are situated in the central cavity of the fibre and are

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therefore relatively ~~[illegible]~~ to chemical attack .. Cellulose is not affected by prolonged boiling with sodium hydroxide solutions of concentrations upto 2%. This makes it possible to change the impurities other than natural coloring matters into soluble compounds which can be washed away with water.

Changes taking place during scouring process

1. Saponifiable oils and free fatty acids are converted into soap.
2. Pectins and pectoses are converted to soluble salts of pectic acid
3. Proteins are degraded to simple soluble amino acids or to ammonia.
4. Mineral matter is dissolved.
5. Unsoponifiable oils are emulsified by the soap formed during the hydrolysis of the saponifiable matter.
6. Adventitious dirt is removed and retained in suspension by the soap.
7. Dressings and sizing materials are broken down into soluble products.

Saponification :

Conversion of glyceride of fatty acids into soap by the use of sodium hydroxide is called saponification'. Oils and fats in the cotton textile are saponified during the scouring process into water soluble products. Vegetable oils, animal fats and mineral oils are not soluble in water vegetable oil is a glyceride of fatty acid when heated with NaOH (Sodium hydroxide) in water

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The oil is split into fatty acids and glycerine. The glycerine dissolves freely in water. The fatty acid reacts with sodium hydroxide forms its sodium salts i.e soap, which is also soluble in water

Vegetable oils + NaOH $\xrightarrow{\text{heat}}$ Glycerine + Fatty acid
(soluble) (insoluble)

Fatty acid + NaOH $\xrightarrow{\text{heat}}$ Soaps sodium salt of fatty acid
[soluble in water)

Emulsification:

Waxes present in the fibre cannot be removed by saponification. Waxes are esters of higher fatty alchols and fatty acids They are hydrophobic and cannot be removed from fibre by converting them into emulsion which can be held in the kier liquor; The The soap formed by the saponification of oils the kier acts as emulsifying agent. In addition to this soap is also added saparetely to the kier along with the other scouring chemicals

Waxes + Soap (already formed by saponification or added) → Suspension or emulsion

Kier used in scouring process.

Kier is a cylindrical vessel, generally vertical capable of holding 1-3 tons of cloth. having of 2.7 m (about 9 feet) and 1.97 m (6½ feet dia). Horizontal kiers have also been use kier are made of

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mild steel of 0.6 cm thick, joined by welding or riveting, kiers are provided with pressure gauge and safty valve. High pressure kiers have a opening at the top through which cloth is introduced or removed.

Kiers types:

Depending on the methods of heating used kiers are divided into three types. namely

1. Those heated by direct steam with the kier
2. Those heated by the indirect steam within the kier (closed - coil)
3. Those heated by indirect steam outside of the kier.

1 Kier heated by direct steam within the kier.

In this type of kier, the rate of heat of heat transfer from the steam to the liquor is maximum because of its direct contact but eha of condensation of a part of steam, which dilutes the liquor and increases the volume of the liquor, generating hydratic pressure when steam is injected some amount of air (oxygen), which was dissolved in the water. This Oxygen degrades cotton under the scouring conditions. Hence hydroxine (H_2N-NH_2) is added to the water to consume the dissolved oxygen.

$$H_2N - NH_2 + 2O_2 \rightarrow N_2 + 2H_2O$$

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2. Kier heated by indirect steam:
In this type of kier, the liquor is heated with closed steam coils inside the kier and therefore the efficiency of heat transfer is lower than that in the first type but there is no dilution of the liquor or increase in its volume or the hydraulic pressure

3. Kiers heated by indirect steam from outside
Same as above expect that the liquor is heated outside the kier

Kier boiling assistants.
Several types of chemicals are used in the kier boiling of cotton textiles and each of them has a specific role to play in the scouring process.

1 ~~Sa~~ Caustic Soda:- NaOH
Saponifiable oils and fatty acids in cotton to soluble sodium soaps.

2. Sodium carbonate :- Na_2CO_3
Fats contained in the size and those difficult to saponify may be more easily eliminated by soda ash

3. Sodium ~~disalphate~~ silicate : Na_2SiO_3
This prevents the formation of iron stains in the fabric. It also contributes to the whiteness of scoured fabric by absorbing the products of decomposition of the natural impurities in cotton.

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4 Sodium bisulphate : $Na_2(SO_3)_2$

Being a reducing agent, Sodium bisulphate prevents any oxygen in the kier from affecting the cotton cellulose.

5 Sodium hexa-meta phosphate - $(NaPO_3)_6$.

This is added to the kier to reduce the hardness of water.

6. Sequestering agent -

Used to reduce the hardness of water. These agents can replace the use of sodium silicate and sodium hexa-meta phosphate

Surfactants (Mainly wetting agents) :-

The term surfactants is a short form of surface active agent. Surfactants poses wetting emulsifying and detergent properties They facilitate penetration of the solution into the fibre and rapidly emulsify wax like substances

Oxidising substances : Sodium hypochloride or hydrogen peroxide (H_2O_2) further disintegrate the decomposition products of the impurities in cotton and as a result the ~~tempo~~ time of scouring is reduced and better whiteness and wettability are imparted to the material.

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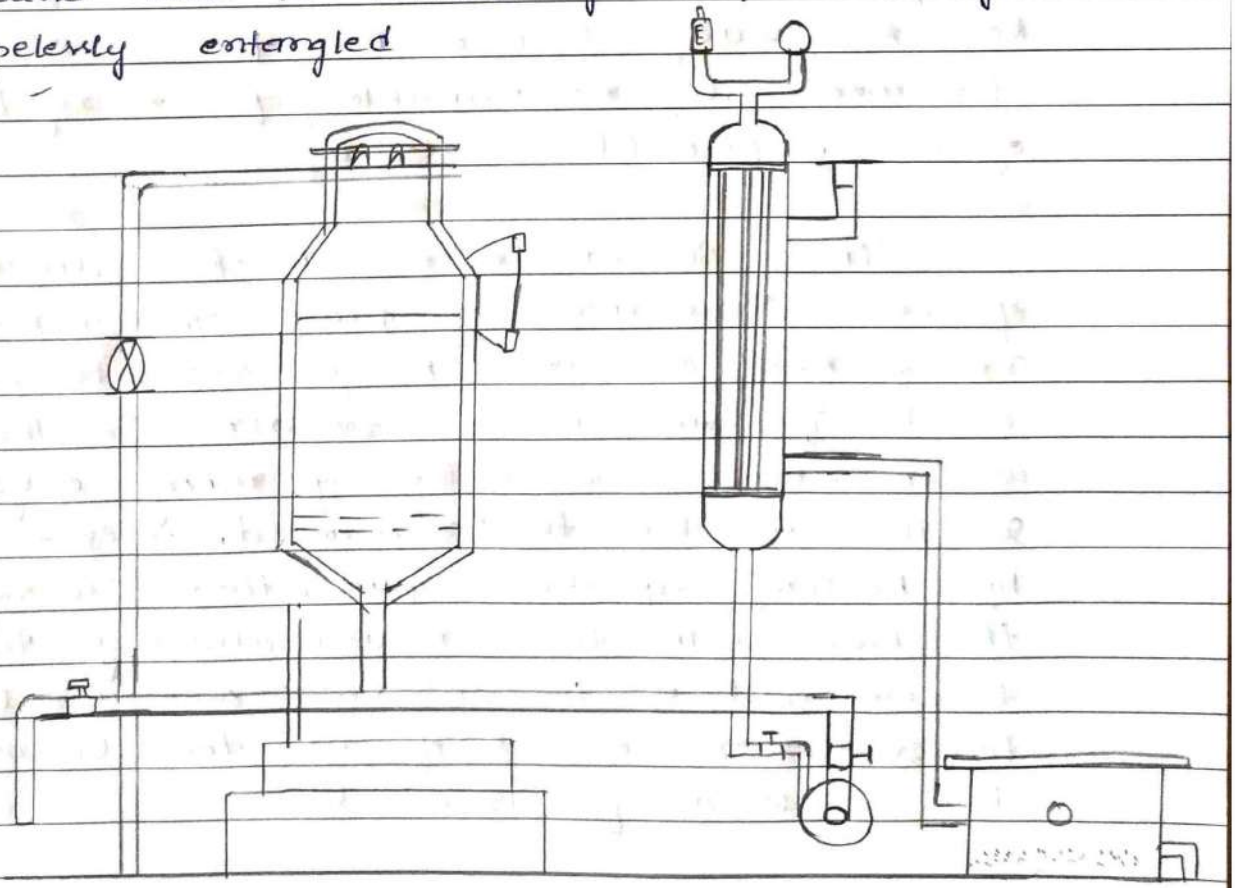
Loading of Kier:

The grey fabric, after desizing is loaded into the kier in rope form by piling it uniformly either by means of an automatic piler or by manual piling with manual piling it is possible to load about 80% of the kier capacity whereas with an automatic piler only about 70% of the capacity is utilized. The kier should not be filled beyond 80-85% of its rated capacity as overfilling may create undue hydralic pressure and would also compress the fabric at the top of the kier and ~~be~~ under the circulation of the liquor. ~~Comes~~ too less a quantity of material, very much below the capacity of the kier, should not be boiled in a large kier, the kier should be at least half full; otherwise the cloth may turn around due to circulating liquor & get hopelessly entangled



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Scouring of yarn in the hank form:

When scouring yarn in the form of hank, there are two ways

One the hanks are linked together by short lengths of cotton twine to form continuous chain of hanks that is convenient to handle as a long rope.

Another way of doing its is to prepare small, loosly tied bundles of the hanks and piles them evenly in the kier.

After the material is piled in the kier, heavy stones are peaced uniformly on it to prevent it from being tossed up during boiling and there by forming channels.

Working in the kier:

After loading the fabric, the kier liquor is let in from the bottom of the kier to sweep out the air inside. The M:L ratio in a kier is usually 1:4 or 1:5 [i.e 5 similar of treatment liquor available for every kilogram of the dry textile material]

There should be enough kier liquor for efficient circulation by pump. The liquor coming into the kier brings with it air, which if allowed to remain in the kier would attack the cotton forming oxycellulose. So the air has to be removed. This is achived by heating up the liquor, then closing the the kier with the lid and allowing the air to come out of the air valve over the lid. For satisfactory removal of air, the liquor should be circulated for 15 minutes

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Cotton contains about 0.5 % of oils and waxes that have to be removed by scouring.

Recipe and condition for cotton scouring

1 Sodium hydroxide - 1 to 1.5 %
2 Sodium silicate - 1 %
3 Soap - 1 %
4 Detergent (wetting agent) - 1 %
5. pH - 10 to 11
6. M:L ratio - 1:5 %
7 Pressure - 1.5 to 2 kg/cm^2
8. Time - 6 to 12 hours

~~Scouring~~ of coloured woven goods.
Coloured ~~borders~~ of sarees and

Scouring of Natural polyamide or protein fibres (silk and wool)

Scouring of wool:

Raw wool contains anything from 30-60 %. of wool grease, wool is rapidly degraded by alkali so that if the natural oils and fats are to be saponified, the alkali must be applied with caution and at temp well below the boil, In practice, sodium hydroxide is never used because the slightest excess would raise the pH above the danger level, and milder alkalies such as sodium carbonate and ammonia or ammonium carbonate are preferred.

Raw wool is scoured by counter current method. There are generally four or five bowls arranged in sequence. The mle consists of long trough provided with make a false bottom at

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the exit. Below the false bottom is a spirally fluted shaft, which when it is rotates, carries the deposited solve the dirt to the centre where there is outlet valve through which it can be discharged

The trough is filled with scouring liquor containing soap and sodium carbonate and the temperature is brought to 35°-40°c. The rakes have a reciprocating movement that makes the wool travel forward beneath the surface of the liquor whilst adequate agitation is maintained to keep the dirt and emulsified grease in suspension as the wool leaves the trough, the excess of soap liquor is squeezed back by the wringers. The wool passing to a second, similar trough, where it usually receives further scouring, since removal of impurities will not be complete in the first. This may be repeated two, three or four times before the wool passes through a final trough where it is rinsed with watch

The composition of the scouring liquor varies considerably according to local practice

Recipe - First bowl - 0.75 to 0.8%.
Second bowl - 0.4 to 0.5%.
Third bowl - 0.25 to 0.35%.
Further bowl - ~~0.25 to~~ water only

Alkali (sodium carbonate)
1 first bowl - 0.2%.
Temperature - 30°-40°c
pH - 10.

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Scouring is carried out 35-40°C and should not exceed 60°C because of the risk of degradation of the wool keratin by the alkali when two or more bowls are scouring in sequence, the counter-flow system is generally used. when the wool is emerges from a trough the receptacle wringers squeeze the excess liquor into a receptacle connected to the preceding bath. Thus there is a gradual transference of liquor from the last to the first compartment, the below being in the opposite direction to that in which the wool is ~~transection~~ travelling fresh soap and alkali is fed into the last tank ~~not~~ so that the wool that is virtually grease free.

Other methode of scouring wool are

1. Solvent scouring
2. Freezing method
3. Emulsion scouring.

Scouring of silk:

Scouring of silk is usually associated with removal of the sericin. The goods are treate for about two hours in a 0.5-0. percent of 30 lts of liquor / kg of silk.

Hostery goods are packed into mesh bags and degummed a rotatory cage type of Scouring machine made out of stainless Steel. Hanks of yarn may into mesh bags and and degummed in the annual cage of a forced circulation machine, yarn is also frequency hang over sticks and scouring in open retongular vessel. Certain degraded in open

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Rectangular vessel certain degraded of alkalinity is necessary to dissolve the Seracin and the hydrolysis of the dissolved soap gives desired pH.

Vigorous movement, contact with rough surfaces, and exposure to ~~un~~ mechanical Stresses are undesirable under such circumstances the fibroin filament ruptures and bundles of the fibrils of which it is composed project from the surface giving

Lousy Silk : Degumming recipe :

* Soap solution - 0.5 to 0.75 %
* Temperature - 95°c
* Time - 2 hours
* M:L ratio - 1:30

Scouring man-made fibres :

Man-made fibres are comparitively free from impurities and much milder methods of Scouring are therefore Sufficient (oils incorperated during spg wvg or knitting)

Fibrics should be scoured in Stainless steel which machines, and not in mfcs with heavy rollers such as those used for wool. The rougher of the coooden machine cause is liable to cause capturing of the threads by plucking them in their weak wet Stable. Rayons yarns are scoured in a ~~Reel~~ hank or package dyeing machine ~~Rectangular~~ regenerated rayon be scoured at 80-90°c with 0.3 solution of soap or a Synthetic detergent Sodium Carbonate upto 1% on the wt of material may be added.

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Recipe - Soda ash - 1 to 2 gpl
Detergent - 1 to 2 gpl
Temperature - 60 - 70°C
Time - 30 min
100% rayon fabrics & 100% polyester

For Acetate :- Recipe
Detergent - 1 g/L
Temp - 85°C
Time - 30 min.

PE/C :- Soda ash - 0.5 to 1% on wt of material
Detergent - 0.2 to 0.5 % on wt of material
Tempr - 100°C
Time - 60-90 min
Alternate recipe
NaOH - 0.2 - 0.5 %
Detergent - 0.2 to 0.5.
Temp - 75°C
Time - 60-90 min

Semi - Continuous scouring for PE/C blends.
Recipe - Sodium Carbonate : 1.5 to 2.5 %
Detergent : 0.3 - 0.5 %

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The above liquor contained in two saturat and the fabric is given a double pad to ensure good pick up of the liquor. The padded fabric is heated in a preheater and the batched up. The chamber is pulled away when the batch is full & attached to a steam line

The fabric roll is kept rotating slowly to ensure uniform distribution of the scouring liquor & the roll & steamed at 90-95°C for 90-120 min, Then the scoured fabric is washed throughly in open soaper.

Continuous process for PE/C fabric

In case of PE/C blends, the fabric is scoured continously in a J-box or vaporlok type of machine

Using J-box

The fabric in the open width state is ~~padded~~ padded through liquor containing 15-25 gpl soda ash and 2-3 g/l of a detergent and then piled into a regular J-box, the fabric is given a dwell period of 60-90 min in the J-box, during which it is maintained at 95-99°C. The scoured fabric then passes on to open width soaping m/c in which it is sucessively and throughly given hot and cold ~~water~~ washes

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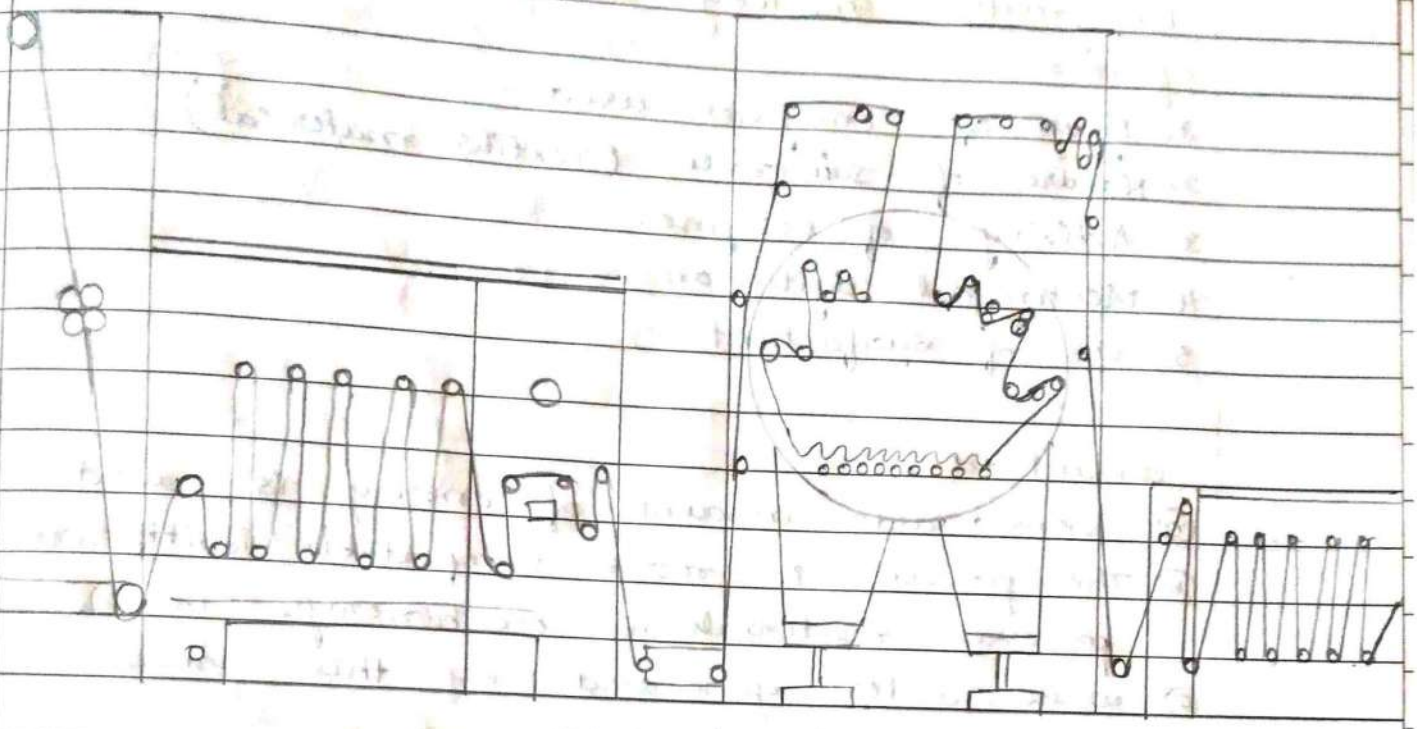
Vaporlok unit :-



- Vaporlok machine

If Steam under high pressure is used, the scouring period can be much reduced. This principle used much in vaporlok machine. The fabric is impregnated with liquor containing 6-12 g/L Sodium hydroxide and 3-5 g/L of detergent in a Saturator as shown in the figure and then Steamed in the special vaporlok chamber at 2-2.2 kg/cm^2 for 90-120 seconds. The goods the pass on to an open Soaper to be washed as usual.

advantage - Process is quick and produces a clearly Seco Scoured fabric with excellent absorbency

Novel methods of Scouring

Enzymatic Scouring

Enzymatic scouring is the latest method is developing into a commercially viable process.

- The process is ecofriendly and uses minimum no/. of chemicals

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Enzymatic scouring is affected by the following factors :-

1. Types of enzymes used
2. Nature of substrate (Textile material)
3. Activity of enzyme.
4. Mechanical agitation
5. Use of surfactant

advantages :

(a) Considerable amount of energy is saved.
(b) This process is more compatible with other processes, materials & machinery.
(c) waste, water generated by this process is more readily treatable

Bio Scouring :-

Bio scouring is the process of scouring of cotton and other materials using the certain special enzymes called pectinase. This process is more ecofriendly and desnot involve the chemicals such as caustic soda and other alkali which are normally used in regular scouring process. In bioscouring a small quantity of pectinase i.e about 0.3 - 1% on weight of material enzymes is used for scouring at a tempr between 40°-50°C for 1-2 hours. Pectinase actually attack the pectin substance present in the cotton very effictively and dissolve them making in very absorbant. The process is convenient at a tempr of about 40° - 50°C which is much below the tempr used for alkali Scouring (100°). Hence the properties of cotton after scouring remain unaffected & helps in further process such as mercerisation dyeing, printing and finishing

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Combined process using enzymes:-

Combined scouring, desizing and bleaching is possible using enzymes where cotton fabric is desized with amyloglucosidase and combined with one two different kinds of pectinase in the presence or absence of cellulase, the treatment bath rich in glucose, is initially reused for biobleaching with glucose oxidase under neutral conditions. Finally all the preparatory processes are combined.

Solvent scouring

Jigger scouring machine

The jigger provides a V-shaped stainless steel vessel for containing the scouring liquor, a pair of upper guide rollers, an immersion roller at the bottom of the vessel and two draw rollers to pull the fabric through the scouring liquor. About 1000 mts of fabric, which may consists of 5-6 % lengths of fabric temporarily stitched together, is wound on one of draw rollers. The liquor in the vessel is then heated up to the desired temperature by means of a perforated steam pipe placed at the bottom of the jigger.

P/C blended fabrics are scoured on a jigger using 0.2 - 0.5 % detergent and 0.5 - 1 % soda ash at the boil for 60-90 minutes. If sodium hydroxide [0.2 - 0.5 %] is used in place of soda ash, the temperature is lowered to 75°C. The goods are washed off to complete the process.

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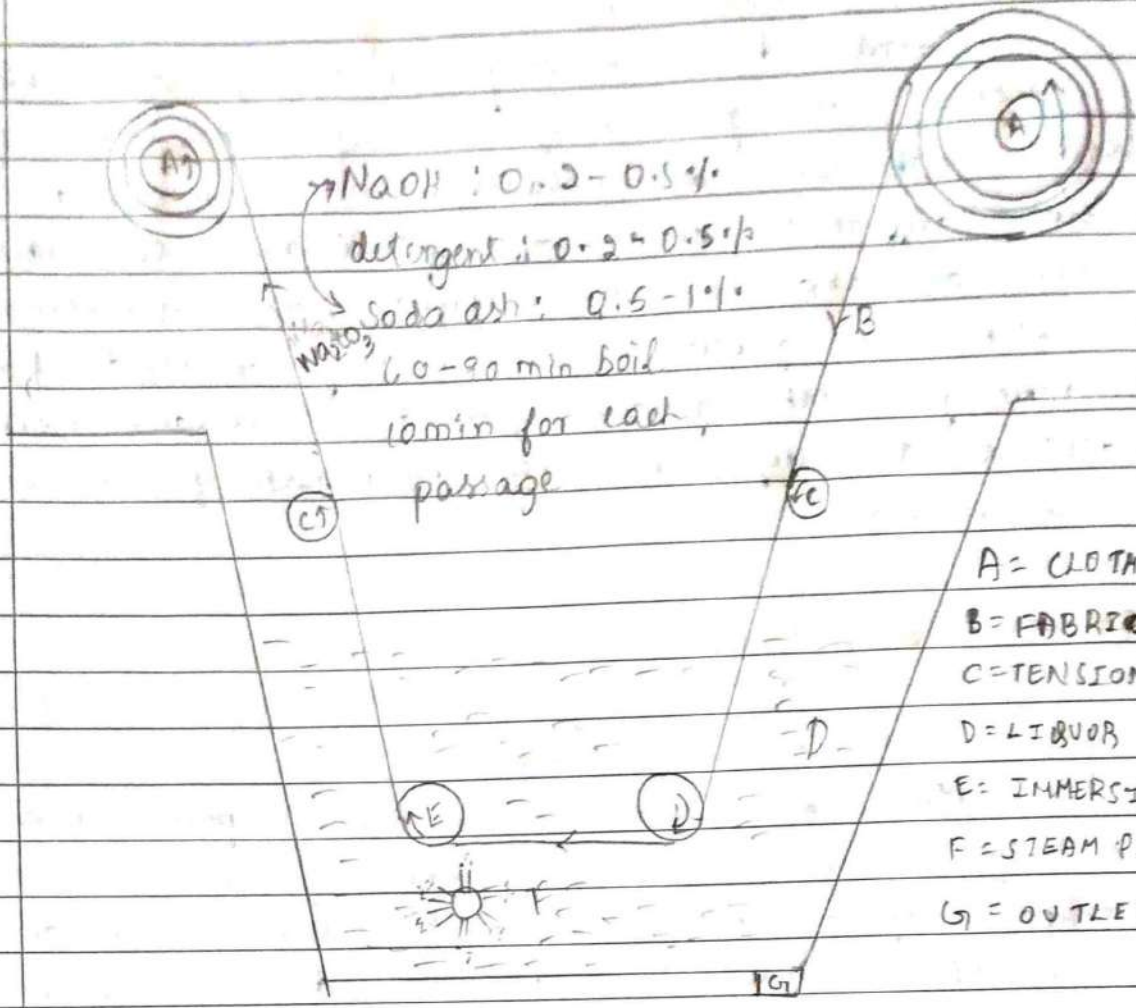

- Winch scouring m/c :-

The winch is quite different from the jigger and consists of a vat (vessel) that has a ~~curved~~ curved back. Over the top of the vat a horizontal which rotated generally by an individual electric motor. At the front a narrow chamber separated by a perforated plate ; so that the main bulk of scouring liquor in the scouring vat can pass through the perforations to mix with the bulk of the scouring liquor the steam and chemical inlets are also located in this chamber, A fabric guide roller of small dia extends above the whole width of the vat and is positioned above the narrow chamber, but closer to the winch and at ~~above~~ about the same height winch is usually

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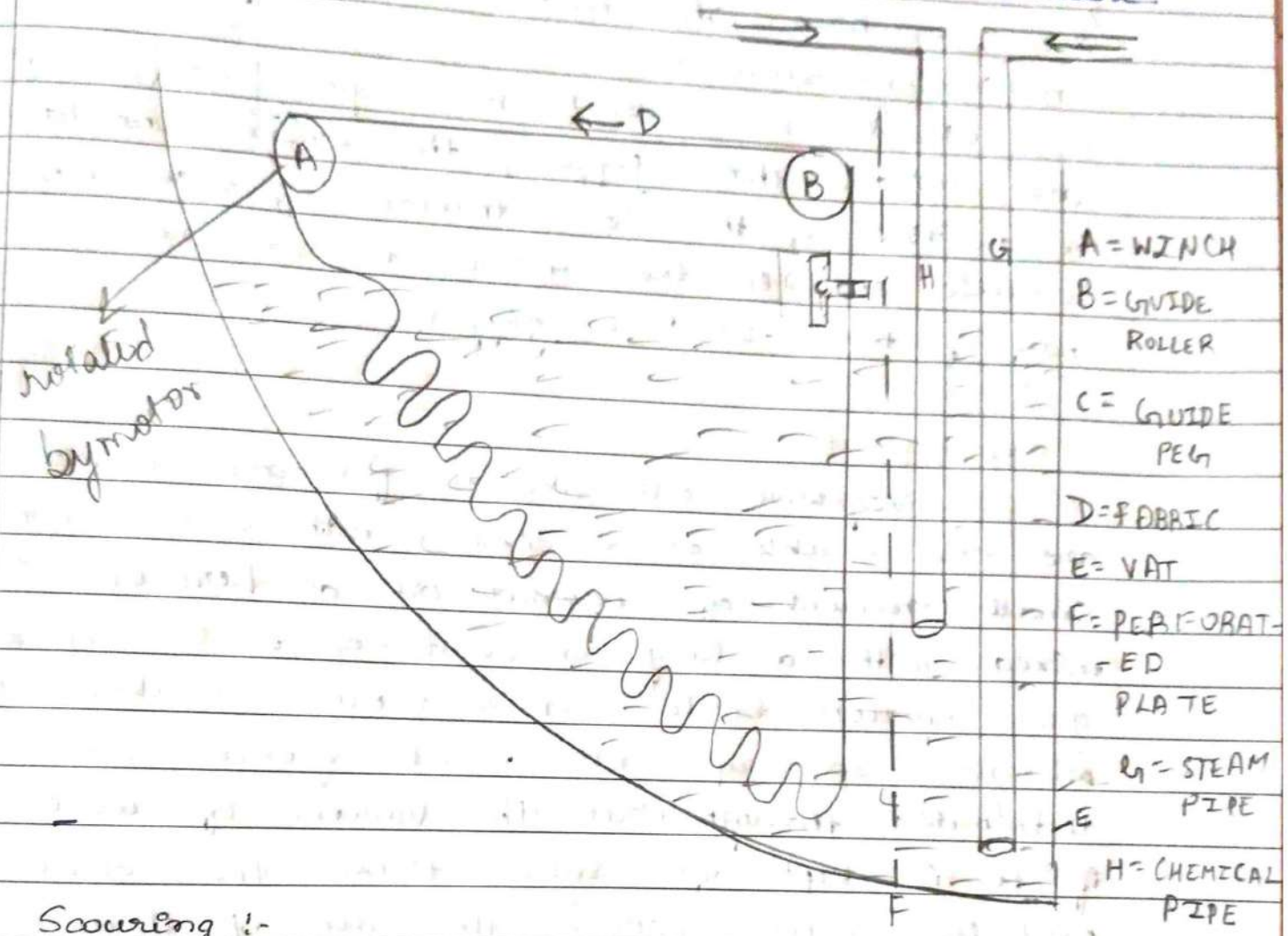
Scoured in rope form in a winch m/c through open-width winches are available.



Scouring :-

The winch is filled with the required vol of water to give the desired material to liquor ratio, which is usually in the range 1:20 to 1:40 at the starting concentrated scouring solution is added to the water at the front chamber while the fabric is running. the scouring liquor diffuses through the perforations of the partioning plate into the main bulk of liquor and scouring and the scouring of the fabric commences

The liquor is heated by means of perforated steam pipe and the temp is raised from 60-90°C depending upon the material scoured

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scoured is continued for 20-80 minutes and fabric is rinsed as usual in cold water in the same machine. The material is finally removed and hydroextracted

Fabric is scoured in rope form, conditions are milder than Jigger, the temp should not exced 75°C & the concentration of soda ash or caustic soda, & the detergent are about half of those used in Jigger

Saponification.

Vegetable oils, animal fats and mineral oils are not soluble or miscible with water. when a small amount of coconut oil or kerosene is mixed with a large amount of water in a glass ~~bottole~~ bottle and vigorously shaken, the oil gets split up into small globles, which are distributed through out the volume of water. But if it is kept for some time, the small oil particles coaleee (join) with each oft them, becoming bigger globules. this continues till all the oil particles form a layer of oil, which then floats on water.

When a wooden stick or a glass rod is dipped in water it will be seen that water sticks to it on removing the same from the water but if the stick a the rod is coated with oil or molten wax and drived then dipped in water will stick to it. This happens become oil and water " hate each oft other and oil coated or wax coated surfaces are said to be hydrophobic or water hating 'surfaces'. Surfaces which can be wetted with water eating are called hydrophobic surfaces. or water ~~hating~~ leveling ~~Soteing~~ surfaces. Fabric containing

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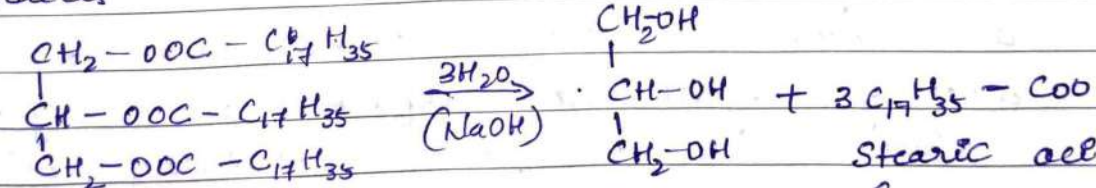
the size (normally contains oil) become hydrophobic in nature and the oil resists wetting of the fabric by water. For further processes such as bleaching, dyeing process etc. to be effective, the cloth should be highly absorbent towards water. To achive this objective the oil has to be remove from the fabric, also china clay is firmly fixed on the grey cloth with the help of oils and waxes, which act as the binding agents for the clay particles. This is the necessary to remove the oils and waxes for removing the china clay from the fabric

A vegetable oil, which is immiscible with water, is glyceride of fatty acids like oleic, stearn, palmitic recialeic acid when such as oil is heated with a solution of sodium hydroxide in water the oil is split up into its constituents, fatty acid and glyceride ~~with water~~ which the better is freely miscible with water The fatty acid reacts with sodium hydroxide present in the solution forming its sodium salt is soap which is also soluble in water This reaction is called 'saponification'. As a result of saponification the insoluble and water immiscible oil is converted into water soluble products



Tristearin (Glyceride of stearic acid) (oil)

Glycerine

Stearic acid (fatty acid)

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$3C_{17}H_{35}COOH + 3NaOH \longrightarrow 3C_{17}H_{35}COONa + 3H_2O$

Stearic acid. Sodium stearate + water (soap)

oil + Caustic soda → soap + Glycerine

If the grey fabric is boiled with a ~~soft~~ of sodium hydroxide the oil should get saponified and after washing the soluble soap and glycerine formed from the oil once removed and the fabric is free from the oil.

However, since the grey fabric resists the wetting of a hydrophobic surfaces with water It is ~~for~~ possible to measure the surface tension of water. It is found to have a surface tension 73 dynes/cm. There are certain Compounds which dissolve in water and reduce the surface tension, For example, it is possible to bring down this value 73 dynes/cm to 28 dynes/cm. by dissolve soap in water. Since surface tension liquid is a force which resists the wetting surface with the liquid; it follow. if this force is reduced considerably possible to wet the surface easily. substance which reduce the surface tension of water ~~Her~~ allowing it to wet surfaces easily which are otherwise non-wettable are known as wetting agent a surface active agents.

Thus when a fabric containing oil is treated with a hot solution of sodium hydroxide in water to which a wetting agent is also added the decrease in the surfaces tension of water brought about by the ~~surfaces~~ wetting agents

facelitate the wetting agent of the fabric with the sodium hydroxide solution, thereby bringing sodium hydroxide into intimate contact with the oil which then gets saponified to water soluble products. The wetting agent does not remove the oil, but only helps sodium hydroxide in removing the oil from the fabric. ordinary soap is a wetting agent. Lissapol, Teepol, Igepon, Indopon, Nakal, Gardinol etc. are some of the trade names of wetting agents available in the market.

Emulsification:

Waxes present in size and natural wax cannot be removed by saponification these are esters of alcohols and fatty acids. Similarly mineral oil such as kerosene, lubricating oil etc. cannot be converted into water soluble products by boiling with sodium hydroxide solution. These oils are also hydrophobic in character. This can be demonstrated by a simple experiment.

Take 50 ml of water in a measuring cylinder Add 2 ml of kerosene over the water. The oil forms a separate layer and floats on the water as mentioned earlier. now shake the cylinder throughly by closing its mouth with the palm of the hand. when the oil is split up into small particles which get dispersed in water. After keeping for some time, the oil particles Combine with each other (Coalesce) to form bigger globules and finally form a layer, which again floats on the surface of water. If Soap or other

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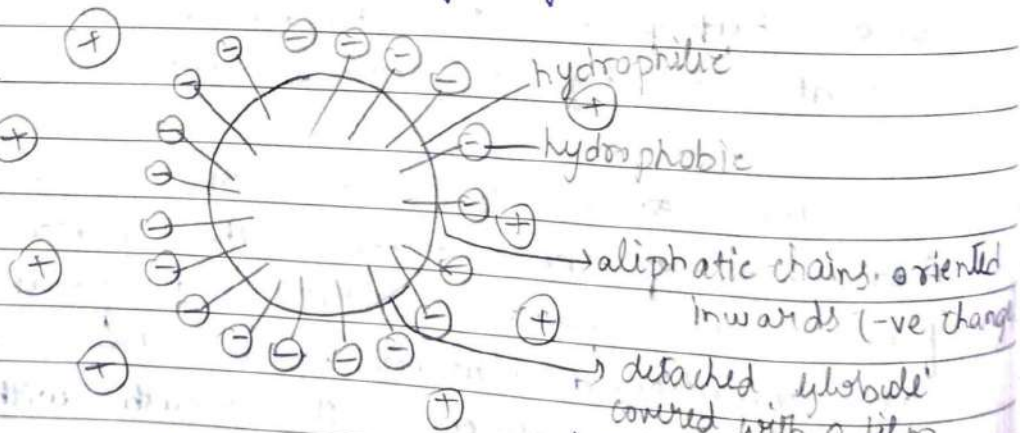
Similar Compound is added to the water before adding kerosene and if the contents of the cylinder are shaken thoroughly a stable dispersion of oil particle in water is formed. This is called an emulsion of kerosene in water and the compound added to the water before making the emulsion is called an emulsifying agent. If emulsifying agent is very efficient the emulsion prepared with remains stable for a very long time (i.e it does not break up into two layers). An emulsion, therefore, is a fairly stable mixture of two liquids, which normally do not mix with each other

. The process of emulsification is used in the scouring of cotton materials, containing non-saponifiable oils and waxes, Thus the scouring solution should also contain an emulsifying agent, in addition to sodium hydroxide and wetting agent. ordinary soap is a good emulsifying agent.



. The detached globules will be covered with a surface film of detergent molecules with the aliphatic chains oriented inwards. The globule will bear a negative charge because a no. of the sodium ions will have migrated. The charges on the droplets

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will cause mutual repulsion, keeping them uniformaly distributed throughout the aqueous phase as a stable solution.

Theory of detergency:

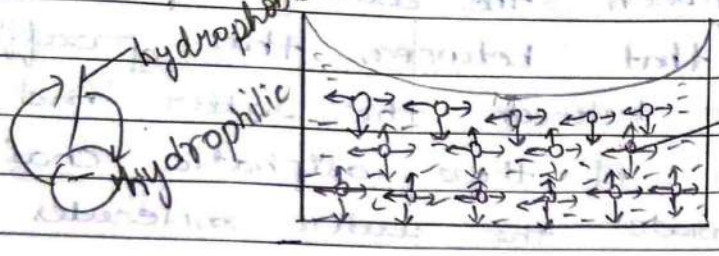
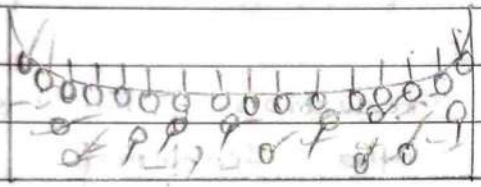


fig (a)

Forces acting on molecules in a liquid.



Distribution of surface active molecules in solution

Surface tension and detergency are closely related. Adjacent molecules in solids and liquids exert attactive forces on each other. There are represented diagrammatically in fig a. It is aparent that the molecules at the liquid / air interface difference from those in the body of the liquid because of the absence of attractive forces at right angles to the surface The result is that the inward pull on these molecules is greater than any of the others creating a tendency for the surface to Contact the phenomenon is referred to as surface tension.

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Surface active compounds such as soaps are ~~used~~ not distributed evenly when in solution but tend to become more concentrated at the surface layer than in the body of the solvent. The reason for this is that the attraction between the water dipoles is greater than that between the paraffin chains and also between the latter and water. The introduction of these aliphatic chains tends to separate the water molecules but the mutual attraction of the latter is so great that the non-polar chains will be forced on of the water phase (fig b)

The reduction is surface tension is caused by the tendency of the hydrocarbon chains to move away from the water interfaces creating a force in a direction opposite to the inward pull on water molecules at the surface. It is suggested ~~that the surface active molecules anion~~ a negative charge because a 20% of the sodium ions will have migrated. The charges on the droplets will cause mutual repulsion, keeping the uniformaly distributed throughout the aqueous phase as a ~~stable solution~~.

that the surface active molecules anion

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Advantages of sodium / calcium hypochlorite bleaching

(a) low fire

(b) low chemical cost

$Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$

(c) low energy input

(d) low cost of equipment

Disadvantages -

(a) more environmental hazards

(b) Rapid bleaching is not possible

(c) danger of yellowing of bleached fibre on storage.

(d) Chances of tendering of the material if the pH and temperature are not controlled

(e) cotton goods must be scoured before hypochlorite bleaching.

(f) imparts harsh feel to the fabric.

(g) low storage stability of chemical (hypochlorite bleach) liquor.

Scouring:

Scouring is an acid treatment generally given to hypochlorite bleached good

Ex- Dil HCl, Dil H_2SO_4

Reasons are :-

(1) Very difficult to remove treaces of alkali even after through washing. The alkali made to be neutralised.

(2) In case of bleaching powder, the calcium carbonate formed during bleaching is deposited on the fabric & cannot be removed by simple washing. It imparts harsh feel.

pH of peroxide	Stability
1 to 3	High
4.5 to 5	good
7.0	medium
11.5 to 13	Lowest

NaOCl

Sodium hypochlorite bleaching.

When cotton goods are to be bleached they are scoured or kier boiled & then uniformly packed into a cylindrical vessel which may made of stone, wood or cement. The vessel has perforated false bottom with an outlet to a tank below (sump) of similar capacity. The liquid in the sump is made of up of the desired conc. of available chlorine with sodium hypochlorite solution. It is then pumped up & sprinkled from the top of cotton goods through which it percolates through the layers to the cotton.

The concentration of available chlorine required in the bleach liquor varies b/w 1-3 gms of available chlorine per litre. The time of treatment depends upon the cotton material being bleached. Highly twisted & close weave fabric required more time. If the ambient temp is high less time is required.

One tonne load of cotton textile may take on average of about four hours for effective bleaching.

Recipe - Bleaching liquor - 1.5 g/L of available chlorine

Temp - Room temp

pH - 10-11 (using a stable buffer)

Precautions - The four variables that affects the bleaching efficiencies are:-

1. Concentration of the bleaching liquor
2. Temp^r
3. pH
4. Time of bleaching.

- Better Concentration - better result but greater risk of chemical damage
- Time & Temp^r must also be standardised
- The pH should be controlled between 10 & 11 fall below 9 separate the degradation of the Cellulose through the formation of oxycellouse

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Dilute hypochlorite bleaching

Bleaching with bleaching powder

Bleaching powder is most successfully and extensively used for bleaching. It liberates chlorine in the nascent condition which is decomposed by water into hydrochloric acid and nascent oxygen. It is this nascent oxygen which is responsible for the bleaching action.

$$Cl_2 + H_2O \longrightarrow 2HCl + [O]$$

Bleaching powder contains about 38% available chlorine because much of the chlorine is present as basic chloride the term available chlorine means the chlorine available for bleaching; the chlorine as $CaCl_2$ (~~Chlorin~~ Ch calcium chloride) is not available chlorine

Bleaching powder:- Bleaching powder is double chloride and hypochlorite of calcium $Ca(OCl)$ when chlorine g is passed over dry slaked lime ($Ca(OH)_2$), it is rapidl absorbed; forming a moist powder which is called bleaching powder as chloride of lime

$$Ca(OH)_2 + Cl_2 \longrightarrow CaOCl_2 + H_2O$$

The water formed remains in the powder

In the manufacture of bleaching powder, slaked lime is spread over the floor of closed lead chambers so as to expose a large surface and chlorine gas is admitted. The powder is turned over wi wooden & reaction between slaked lime & chlorine is continued till the absorption of the gas is complete. This takes 12-14 hrs. The final product contains 35-37% of chlorin present as $CaOCl_2$ (calcium hypochloride) some free lim is also present in the final product.

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Properties of bleaching powder.

Bleaching powder is a white amorphous powder having the smell of chlorine. In contact with air (moisture & carbon dioxide) it is rapidly decomposed and hence could be stored in air tight containers. bleaching powder contains about 10% free lime (calcium hydroxide) A good sample of bleaching powder contains about 38% available chlorine. when mixed with water, it tends to form a hard-cake, unless finely ground previously after adding a little amount of water and this paste is added to a larger amount of water with stirring. The free lime or lime present saturates the water and the excess lime as well as the insoluble impurities settle at the bottom as the sludge A solution of bleaching powder contains calcium hypochlorite ($Ca(OCl_2)$), calcium chloride ($CaCl_2$), lime ($Ca(OH_2)$), hypochlorous acid (HOCl) formed contains calcium hypochlorite, calcium chloride, and other soluble impurities like Calcium chlorate, calcium permanganate etc...

Preparation of bleaching powder solution

Some precautions have to be taken during the preparation of bleaching powder sol^n. If hot water is used the hypochlorite is rapidly decomposed and if very cold water is used, The dissolution is incomplete A temp^r of about 25°C is the most suitable one. [The bleaching powder may be added into a tank provided with an agitator. It is preferable to sieve the powder before adding to the tank. After suitably agitating the mixture for 15-20 min and after the sludge settle at the bottom of the tank the clear liquor may be run off. Fresh water may be added the sludge agitated & then allowed to stand.

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Lump formation during dissolution of bleaching powd should be avoided. [The powder should be ground be made & then diluted]. Certain Keller Alkali Co. Ltd. recommended the following conditions.

(a) The water should have a temperature of 21° - 26°C

(b) The liquor should be mechanically agitated

(c) The bleaching powder should be gradually added to the tank, which is filled ½ rd of its capacity with water. After crushing the lumps agitation should be continued for 20 min. The tank should be filled with water, agitated for 10 min more and the contents allowed to stand for the sludge to settle

(d) Sufficient sludge space should be provided and the liquor run off : pipe must be fixed a few inches above the sludge level in the tank.

(e) After running-off the clear liquor the tank shou be filled up with water, agitated and again allowed to settled. The clear sol^{n} is added to the earlie sol^{n} & the sludge is usually dumped.

Comparison of bleaching powder with sodium hypochlorite as bleaching agents.

1. One of the difficulties of bleaching power is the sudge which is formed during the preparation of the sol^{n} & which has to be disposed off. No insoluble products are formed during bleaching wit sodium hypochlorite and there is no sludge disposa problem.

2. The residual lime and calcium salts remaining in the fabrics bleached with bleaching powder impart harsh feel to the fabrics & these have to be remov by souring using hydrochloric acid.

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3. Due to the lower ionic size of sodium ion than that of the calcium ion. Sodium hypochlorite has a higher diffusibility. Therefore there is more through penetration of the bleaching agent in to the fabric in the case of sodium hypochlorite than bleaching powder. Due to greater differsibility of sodium hypochlorite a shorter time of bleaching may be sufficient.

4. There is a dough of the [pH of the bleaching powder solution approching 7 which subsequently enhances the degradation of cotton cellulose considerably. Since hypochlorite soln are the most active at pH 7 for bringing about the oxidation of Cellulose] ∴ Sodium hypochlorite is at before bleaching agent than bleaching powder

5. Freshly prepared bleaching powder soln has been found to be less active bleaching agent than old soln. This has been allouted to attributed lowering of the pH of the soln by neutralization of a part of Calcium hydroxide by atmospheric Carbon dioxide

6. From the storage point of view Sodium hypochlorite soln have a definite disadvantage over bleaching powder especially in hot climates like in India.

7. Dry bleaching powder can be stored for a larger time than sod. hypochlorite soln.

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Hypochlorite bleaching by sodium hypochlorite [$NaOCl_2$]

Sodium hypochlorite the salt of hypochlorous acid (HOCl) does not exist in the solid form, but an aqueous sol^n of the some can be prepared. The stability of this sol^n depends on

1) the temp^o. 2) the pH. 3) Concentration
4) Presence of impurities 5) Storage condition (whether exposed to lightened)

Sodium hypochlorite sol^n decompose spontaneously under favorable condition. It undergoes self decomposition as follows

$2NaOCl + NaCl + NaClO_2$. Sod. Chlorite

$NaOCl + NaClO_2 \longrightarrow NaCl + NaClO_3$ (Sodium chlorate)
Sod. Chloride.

(or)

$3NaOCl \longrightarrow 2NaCl + NaClO_3$

In addition to these chemical reaction Sod. hypo-chlorite undergoes another decomposition reaction which slower than decomposition

$2NaOCl \longrightarrow 2NaCl + O_2 \uparrow$

Oxidation of cellulose with sodium hypochlorite So

Oxidating agents may be arranged in the increasing order of their oxidizing ability as follows

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results when all the dichromate is converted into chromic acid. when the oxidation potential of the soln is plotted against the pH of the soln a straight line is obtained fig (a)

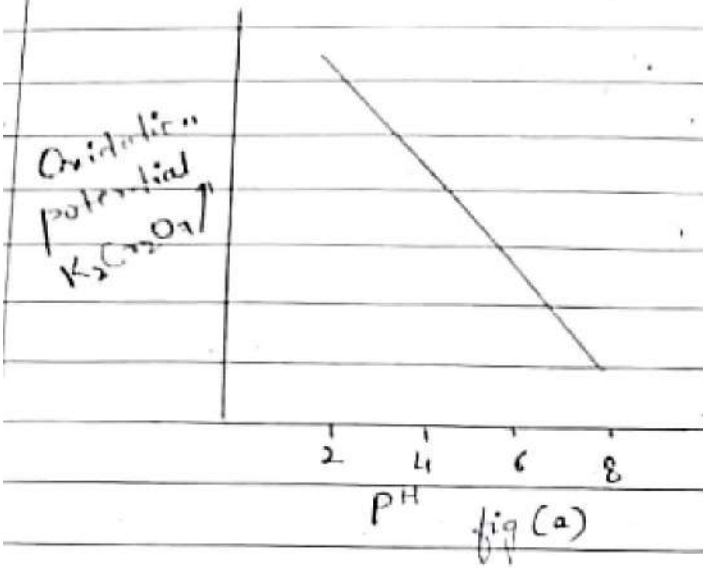

fig (a)

This shows the extremly high oxidising ability of dichromate soln, under highly acidic conditions. the corresponding curve in the case of sodium hypochlorite soln is shown in fig (b)

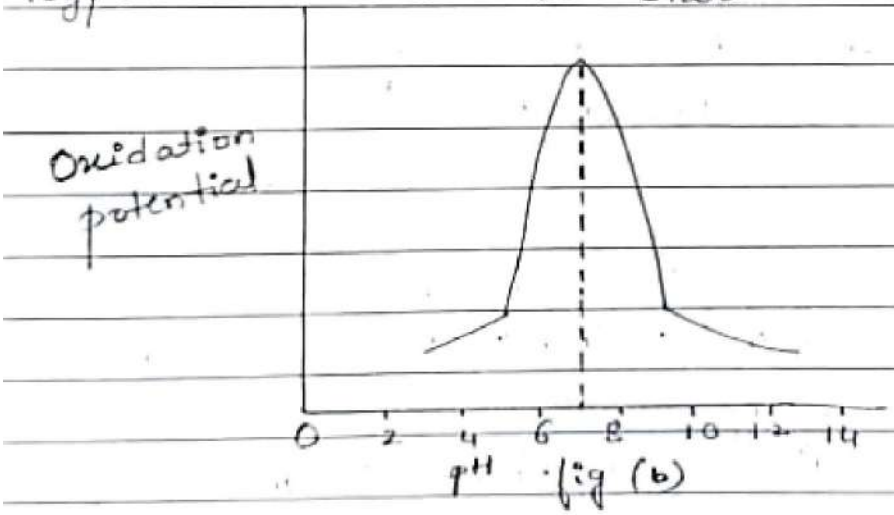

fig (b)

It is seen that the oxidation potential of the hypochlorite soln is at a maximum when the pH is 7 and that it sharply decreases in either side of neutrality. It is also seen that the change in the oxidation potential beyond pH 9 or below pH 4 are not substantial, while between pH 4 and 9 even a small change in the pH brings about a..

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considerable change in the oxidation potential. Hence in practical bleaching the pH range 4-9 is not used. when a pH variation of ± 0.5 is the usual practice.

A Corresponding curve for pottasium permanganate oxidation of cellulose is also in fig (c) for comparision. It is seen that the permanganate sol is least active at pH 7 and that its activity increases if the pH either increased or decreased in contact to the hypochlorite soln. which produces maximum total oxygen consumption at pH 7

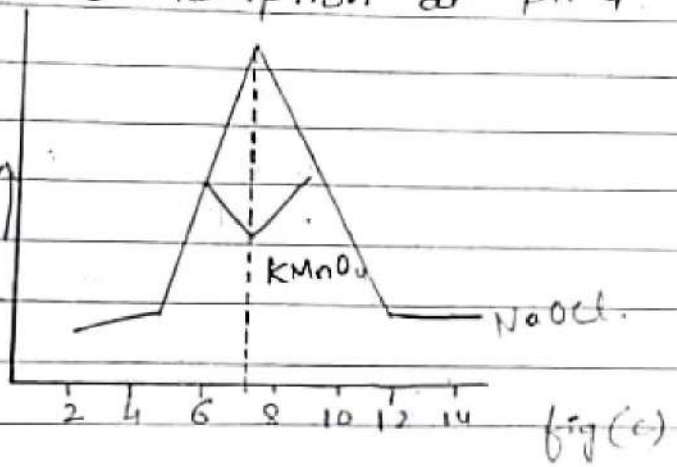
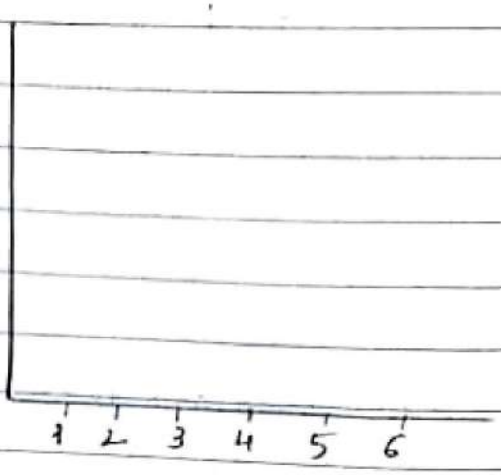


fig (c)

Concentration of sod. hypochlorite.

The rate of oxidation of cellulose with Sodium hypochlorite is found to increase with the conc. of the oxidizing agents upto a conc. of about 5g/litre of available chlorite with further increase in the conc. of the oxidizing agents the rate of oxidation does not increase.

fig (d)



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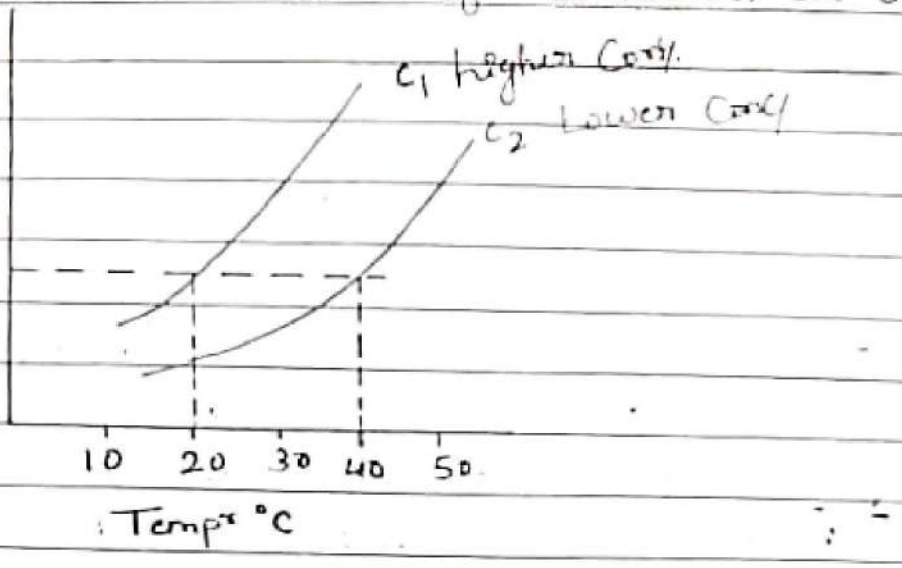
The effects of temp and of conc of sodium hypochlorite on the rate of oxidation as shown fig:



It is seen that the rate of oxidation of cellulose increases with temp at both the conc of hypochlorite more. So that at the higher conc. At higher temp (35°-40°C) weaker soln may be used to get the same rate of oxidation as at 20°C. The soln at 40°C should be approximately half that at higher temp excessive oxidation of cellulose results (over bleaching)

Time of Contact: Longer the time of contact of cotton with the oxidizing agent longer is the amount of oxygen transferred to cotton from the soln. In the actual bleaching practice with proper temp, pH, conc. and time of contact, good bleaching is obtained without too much loss in active chlorine by way of chlorate formation and way of oxycellulose formation. For ex of a soln containing 2g/litre of available chlorine required 2 hrs for obtained in lay 90 min by using a soln containing 40 g/litre of available chlorine.

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Preparation of sodium hypochlorite

There are three methods available for the prepara of sodium hypochlorite.

1) By passing through gaseous chlorine in to a cold sol^n of Sod. hydroxide.
2) By adding Sod. carbonate in to a cold sol^n of Sod hydroxide Sulphate (or) hydroxide to an aque sol^n of bleaching powder
3) By electrolysing a sol^n of Sodium Chloride.

Chlorine is a by product of Caustic soda industry and is available as liquid chlorine com- -ered & stored in cylinders. Before this was availa the last two methods of making hypochlorite we employed. The availability of chlorine at a reasona cost has made it possible to prepare Sod. hypochlori easily even in textile mills.

when Chlorine gas is paired through an aque sol^n of Sod. hydroxide the following reactions takep

$$2\,NaOH + Cl_2 \longrightarrow NaCl + NaOCl + H_2O$$

$$2\,NaOH + 3Cl_2 \longrightarrow 5\,NaCl + NaClO_3 + 3\,H_2O.$$

These are exothermic reactions and since Sod hypochlorite is unstable at higher temp^r and since sodium hypochlorite is converted into Sod. Chlorate self decomposition and hence the sol^n loses its bleaching action a cooling system should be Suitable for satisfactory conv provided during th preparation of Sod. hypochlorite, A low temp^r of 5-1 is found to be suitable for satisfactory conversi of Sod. hydroxide in to hypochlorite. As the reac proceeds the Concentration of Sod. chloride goes on increasing and since its solubility does not vary considerably with temp^r Sod. chloride separates as Crystals from the sol^n, At the end of the reaction

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period sod. chloride should be filtered off and the filtered contains sodium hypochlorite and some amount of sodium chloride as well as some sod. chlorite. If the theoritical amount of sod. hydroxi is used the hypochlorite sol^{n} because neutrol at the end of the reaction & the sol^{n} extremaly

Bleaching

- cotton wax, natural fats and added fatty matters & other impurities - removed in scouring
- Material is more absorbant- cond
- yellowish & brown discoloration: flavone pigments of cotton flower.
- Climate, soil, drought & frost - cause yellowness.
- Object: to produce white fabrics by destroying the coloring matter using bleaching agents; Min degradation
- Bleaching agents; Either oxidises & reducing agents
- coloring matter: No harm, diminishes whiteness
- dye dark shades; no bleaching regd,
- light shades : Bleaching is imp.
- First primitive method: 1756.
- 20th century lots of development: reduced time reduced power & cost.
- 1920: chlorine based materials predominated
  : sodium hypochlorite.
  : calcium hypochlorite
  : sod chlorite.
- 1940; Peroxide bleaching used.

Today 90% of goods bleached - H_2O_2.

Bleaching Agents

Oxidising Bleaching Agents.		Reduced Type
Peroxide system	Chlorine system.	
• Hydrogen peroxide	• Bleaching powder.	✓ Sulphur dioxide
• Sodium peroxide	• Sod hypochlorite	✓ sod hydrosulphite
• Sod perborate	• Li hypochlorite	- sulphoxylates
• Potassium permanganate	• sod chlorite	- Acidic, sod sulphite
• Persulfic acid	• chloramine	- sod sulphites.
• Other peroxides.	• Isocynal chloride	

Oxidising: Nascent [O] decomposes coloring matter into simple compounds and washed away.

- DO not bleach in later stage.

Reducing: Nascent-[H] combines with coloring matter & produces colorless compound remains in the fabric.

Eff Bleaching process must ensure:

- Pure and permanent white
- Level dyeing properties: (over & under affects dyeing)
- Fabric does not undergo tendering

Bleaching with Hypochlorites:-

- Still popular: anti chlorin dobby & enviormental PA

1. Calcium hypochlorite (Bleaching powder):

- Most sucessfully and extensively used.
- Liberates chlorine in nacent condition, which is decomposed by water into HCl and releases [O].
- [O] responsible for bleaching action.

$$Cl_2 + H_2O \longrightarrow 2HCl + [O].$$

- Bleaching powder contain; 35% chlorine

Available chlorin means: chlorine available for bleaching

Bleaching powder:-

Manufacturing Process:-

- Slacked lime spread over the floor in closed chamber
- Chlorin is admitted.
- Powder is turned over & reaction continuous
- Take 12-14 hrs:
- Final product consists: 35-37% of chlorin present as [$CaOCl_2$] calcium hypochlorite.

$$Ca(OH)_2 + Cl_2 \longrightarrow CaOCl_2 + H_2O.$$

(Bleaching powder).

- Extensively used
- Its a double chloride & Hypochlorite of calcium. [$Ca(OCl)Cl$]

Properties:-

1. White amarphous powder.
2. Smell of chlorin.
3. Stored in air light containers
4. contain 10% free lime
5. 38% available chlorin.
6. When mixed with water tend to form hard cake

Solution of Bleaching powder contains:-

- Calcium Hypochlorite : $Ca(OCl_2)$
- Calcium chloride : $CaCl_2$
- Lime : $Ca(OH_2)$
- Hypochlorous acid : HOCl

Preparation of Bleaching powder solution.

Precautions:-

- Ist sieve the powder.
- If hot water : Hypochlorite rapidly decomposes.
- cold water : dissolution is incomplete.
- 25° temp : most suitable.
- Bleaching powder is added to tank provided with agitator.
- Agitate 15-20 min.
- sludge settle down
- Clear liquor runs-off
- again add fresh water agitate, allowed to settle down, clear liquor runs off.
- avoid lump formation.

Conditions:-

1. Temp of water should be 21-26°c
2. Liquor should be mechanically agitated.
3. Bleaching powder - gradually added
4. After crushing the lumps agitation should be continued for 20 min.
5. continue agitation & allowed to settle down.
6. Pipe should be provided few inch above the sludge & liquor runs-off.
7. Separate the sludge.

Sodium Hypochlorite Bleaching:-

- Its a salt of Hypochlorous acid [HOCl].
- Exists in aqueous form
- Stability depends on

✓ Temp ✓ concentration ✓ Storage cond (Exposed to light & not.
✓ pH. ✓ Presence of impurities

NaOCl decomposes spontaneously (self decomp.) as follows

$2NaOCl \longrightarrow NaCl + NaClO_2$ (sod chlorite)

$NaOCl + NaClO_2 \longrightarrow NaCl + NaClO_3$ (sod chlorate)

Sod hypochlorite undergoes another decomposition reaction which slower than 1st one.

$3NaOCl \longrightarrow 2NaCl + O_2 \uparrow$.

In the presence of cellulose the chlorite formation reaction is supressed (12-25%) instead of about 95% in the absence of cellulose.

The extent of chlorite formation reaction in the presence of cellulose is increased by

1. Rise in temp. over the range of 30-60°C
2. PH.: The extent of chlorite formation at PH of 7

Oxidation potential of Bleaching agents.

Arranged in the increasing order of their oxidising ability.

$NaClO_3 < NaClO_2 < H_2O_2 < K_2Cr_2O_7 < KMnO_4 < NaOCl$.

sod chlorate — sod chlorate — Hydrogen peroxide — pot dichromate — pot permanganate — sod hypochlorite

Oxidising ability – Oxidation potential greater the oxidation potential, greater is the intensity of oxidation.

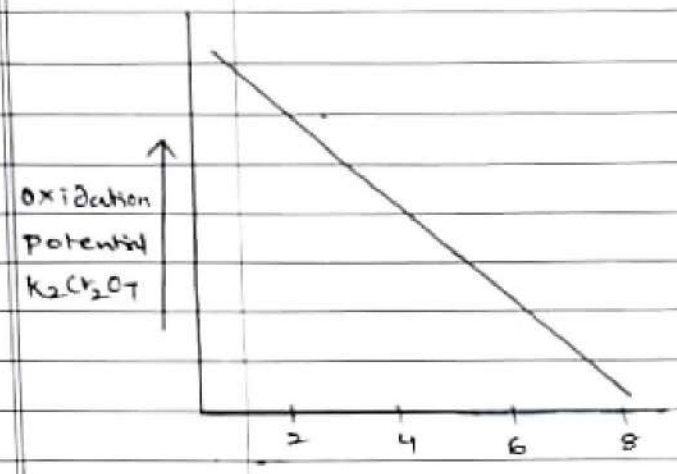
Ex:- Aqueous sol of $K_2Cr_2O_7$ freshly prepared, a PH of 6. may be obtained.

on acidifying acquires more & more oxidising activity. when all dicromate is converted into chromic acid.

PH means -ve Hydrogen ion concentration

→ 1 acidic 7 Alkaline 11

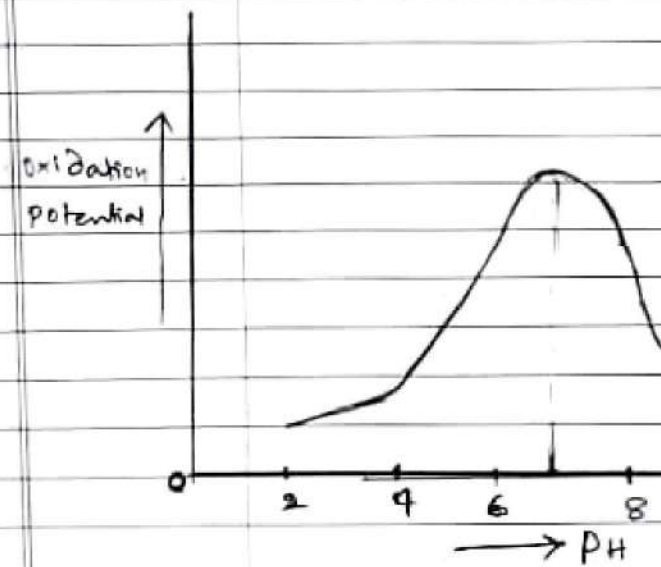
1. Oxidation potential V/S PH:



In graph:

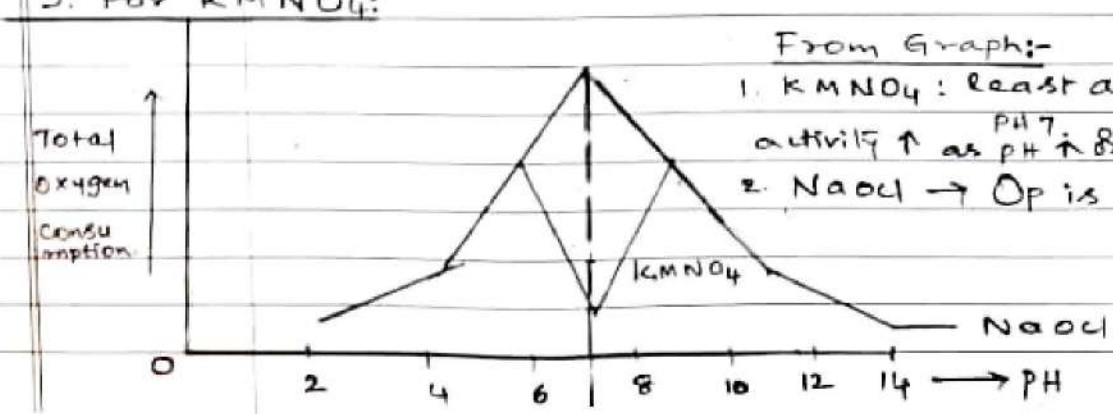
High oxidation potential of $K_2Cr_2O_7$, at highly acidic condition.

2. For sodium Hypochlorite: (NaOCl).



- Oxidation potential is Max when PH - 7
- Sharply decreases either side of neutrality.
- Oxidation potential below 4 & beyond 9 are not sustainable
- PH b/w 4 & 9 - small change in PH brings considerable change in Op
- In practical Bleaching PH: 4-9 not used.
- PH variation of ± 0.5 units

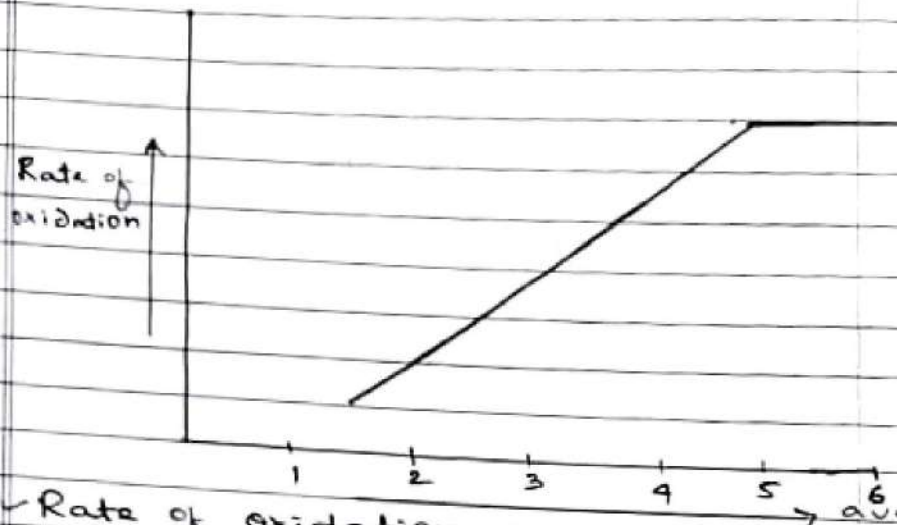
3. For $KMnO_4$:



From Graph:-

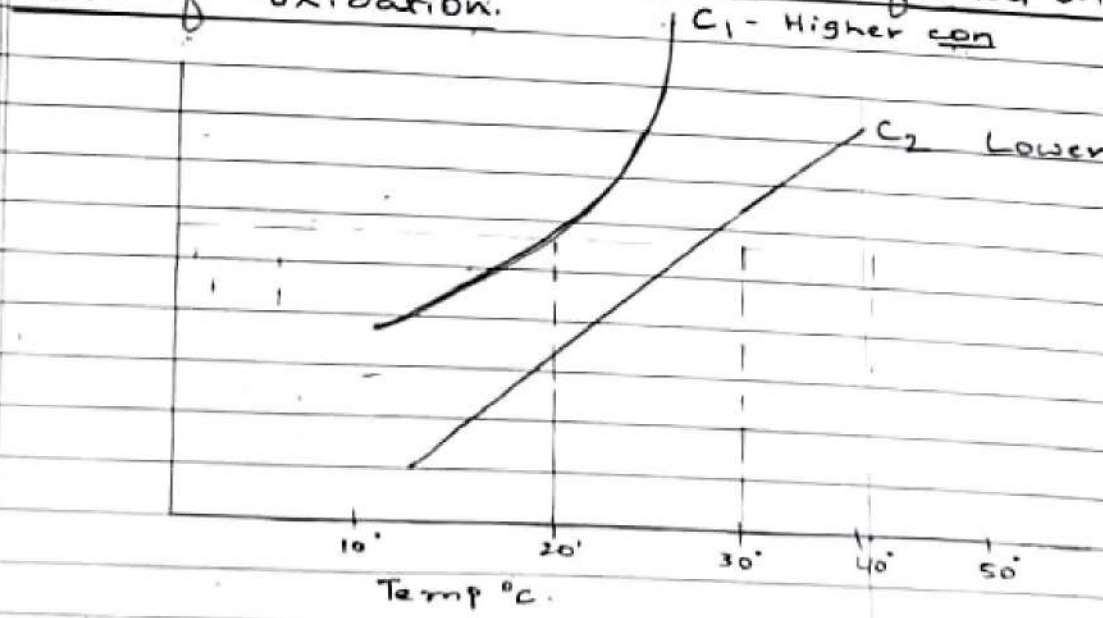
1. $KMnO_4$: least active at activity ↑ as PH ↑ & ↓
2. NaOCl → Op is max

Concentration of NaOH.



- Rate of oxidation of cellulose with NaOH is found increase with con of oxidising agent up to con of 5 gm/lt available chlorin.
- Further increasing in the con of oxidising agent the rate of oxidation does not increase appreciably

Effect of Temp and concentration of NaOH on the rate of oxidation.



- Rate of oxidation of cellulose ↑ with ↑ Temp at both con of Hypochlorite.
- So at higher Temp (35-40°C) weaker sol may be used to get the same rate of oxidation as at 20°C.

If stronger sol are used at higher temp, excess -ve oxidation of cellulose results. (Over Bleaching)

Time of contact:

- Larger the time of contact of cotton with oxidising agents; larger the amount of oxygen transferred from a soln

In actual practice:
With proper: Temp.
pH
concentration &
Time of contact,
Good bleaching is achived.

COMPARISONS:-

	Sodium Hypochlorite (NaOCl)	Calcium Hypochlorite
1.	Hypochlrous acid: Liquid form	Double chloride of calcium (CaOCl2) & Hypochlorite: powde
2.	Presence of Cl_2: responsible	Chlorine is responsible
3.	Expensive	Cheap.
4.	Neutral pH should be avoided	same. 10-11
5.	Inspite of high cost - NaOCl preferred. NO sludge, $NaOCl_2$ reacts with CO_2 in air resulting Na_2CO_3 - soluble	Bleaching powder reacts with CO_2 prese in air, forms insol $CaCO_3$, deposits on fabric - harsh feel.
6.	NO change in pH of sol during Bleaching.	Variation in pH due to formation of $CaCO_3$ & chlrous acid, pH redu -ces from 12-6, which is harmful.
7.	Can expressed in gm available Cl_2	- Same -
8.	Liberates chlorin, not Eco-friendly	- same -
9.	Storage & transportation is difficult.	Transportation & storage is Easy.

Process:-
- Goods are piled.
- NaOH sol sprayed.
- percolates - pump again - spray

SOURING:-

It is an acid treatment generally given to hypo chlorite bleached goods.

Necessity:-
- Difficult to remove traces of alkali, need to be neutralised, get concentrated, formation of oxycellulose In case of Bleaching powder.

- Calcium carbonate ($CaCO_3$) formed deposited on fabric. Difficult to remove, imparts harsh feel.

Souring process:-
- Dil Hcl at RT used:
- Goods using rope washing m/c for 30 min to 1 Hr.

Dil H_2SO_4 may also be used but not suitable for the goods bleached with NaOCl - formation of calcium sulphate gives harsh feel.

Antichlor Treatment:-

After NaOCl bleaching;

Residual chlorin: forms chloramines - yellowing

Antichlor treatment suggested;
- Dil Sodium bisulphate @ $NaHSO_3$
- Sodium Thiosulphate @ $Na_2S_2O_3$
- Sodium hydrosulphate. $Na_2S_2O_4$

Activated Bleaching:- (Accelated Bleaching):

commercially:

(1) NaOCl is successfully carried out at PH 9.5 to 10.5 Process takes long time; 2 - 3 Hrs. to complete.

In such condition one method suggested: addition of 2 - 10 g/l of sodium bicarbonate to the bleaching liquor of con 1 - 2 g/l available chlorine. Bleaching action is completed within 2-3 min

Preparation of NaOCl:- (Sodium Hypochlorite)

Three Methods:

1. Passing gaseous Cl_2 into cold sol of NaOH.
2. By adding Na_2CO_3, Sod sulphate, & NaOH to an aqueous solution of bleaching powder.
3. Electrolysing a sol of Nacl.

Ist Method:

Chlorin gas passed into a aqueous solution of NaOH.

$2\,NaOH + Cl_2 \longrightarrow NaCl + NaOCl + H_2O$

$2\,NaOH + 3Cl_2 \longrightarrow 5\,NaCl + \underset{\text{Sod chlorite.}}{NaClO_3} + 3H_2O.$

- Exothermic.
- Sod chlorite: unstable at high temp,
  : self decomposes,
  : looses its bleaching action.
- Cooling system should be provided.
- Low temp: 5°-10°C suitable.
- Reaction continous, Nacl con↑, separates as crystal.
- Nacl - filtered off.
- Filter sol contains: NaOCl, Nacl, Sod chlorate,
- Store away from light.
- Stability depends on con of NaOCl.
- If it contains 200 g/lt available chlorin comparitively unstable, while a soln containing 50-100 g/lt available chlorin is fairly stable.

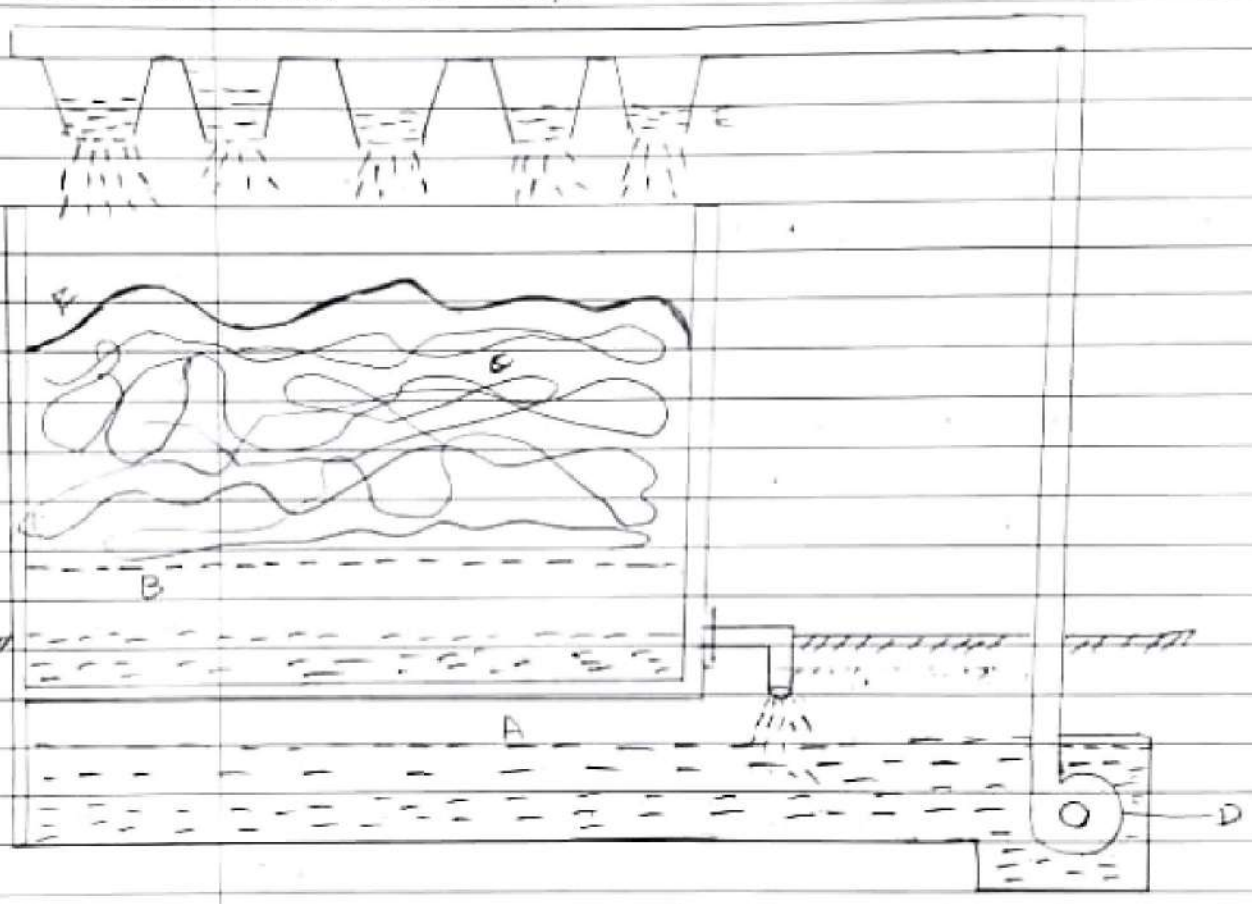
Bleaching with NaOCl:-

- Scoured fabric.
- Neutral condition.
- From Kier - wash - sQ.
- Impregnation - rope washing m/c.
- Cement tank & pits.
- Stored at RT - till completion (3 Hrs).
- First rapidly, then slows down.
- After 3 hrs, waste to continue.

Efficiency depends on:

1. Thorough impregnation.
2. Uniform distribution of liquor.
3. control of con & Temp of bleaching liquor.
4. Proper degree of aeration.

Circulation method:- NEUTE P 49



Cistern: stone or cement

- 02 ton capacity
- Rope form
- Perforated base: Drinage.
- Two outlets < chemicking / Drain

A - Sump (Bleaching liquor)
B - Perforated false bottom
C - cloth (or) Hank yarn
D - Pump
E - Sprayer
F - Thick cover fabric

Recipe:

Sol contains;	M:L :: 1:5
1-4 g/lt available chlorin.	
Temp:	R.T.
PH	: 10-11
Time	: 4-12 Hrs.

(2) Another method:

Hydrogen peroxide is used:

1st goods are padded with hypochlorite (1gll available chlorin) for one min, squ to 100 % allowed to stand for 10-20 min & then without washing, subjected to peroxide bleach.

Advantage:-

1. considerable savings in
   - Peroxides
   - Stabilizers &
   - Alkali
2. Rapid action, formation of nacent [O].

$$NaOCl + H_2O_2 \longrightarrow NaCl + H_2O + 2[O].$$

Nacent oxygen released consumed in useful bleaching

(3) Accelarated Bleaching at elivated Temp:-

Rapid bleaching may be done at 60-80c containing 0.9 - 1.6 % of active chlorin (a.c.f.) in the PH range of 8.6 to 12.8

Disadvantages of sodium hypochlorite:

1. Does not produces satisfactory white inspite of many advantages.
2. slight damages to cellulosic fibres
3. not suggested to synthetic fibres; damages.
4. Requires corrosion resistant equipment.
5. Produces unpleasant odour.
6. Harmful to skin.
7. Produces harsh feel.
8. Stabilization of NaOCl is difficult.
9. Formation of highly toxic chlorinated organic biproducts during bleaching has limited use. Hazards to the drinking water resource when discharged.

Parameters in peroxide Bleaching operation.

Optimum conditions for bleaching with H_2O_2 affected

- Nature & quality of the goods.
- Amount of bleaching &
- Equipment available.

Following are some of the important consideration

1. Effect of Temperature:-

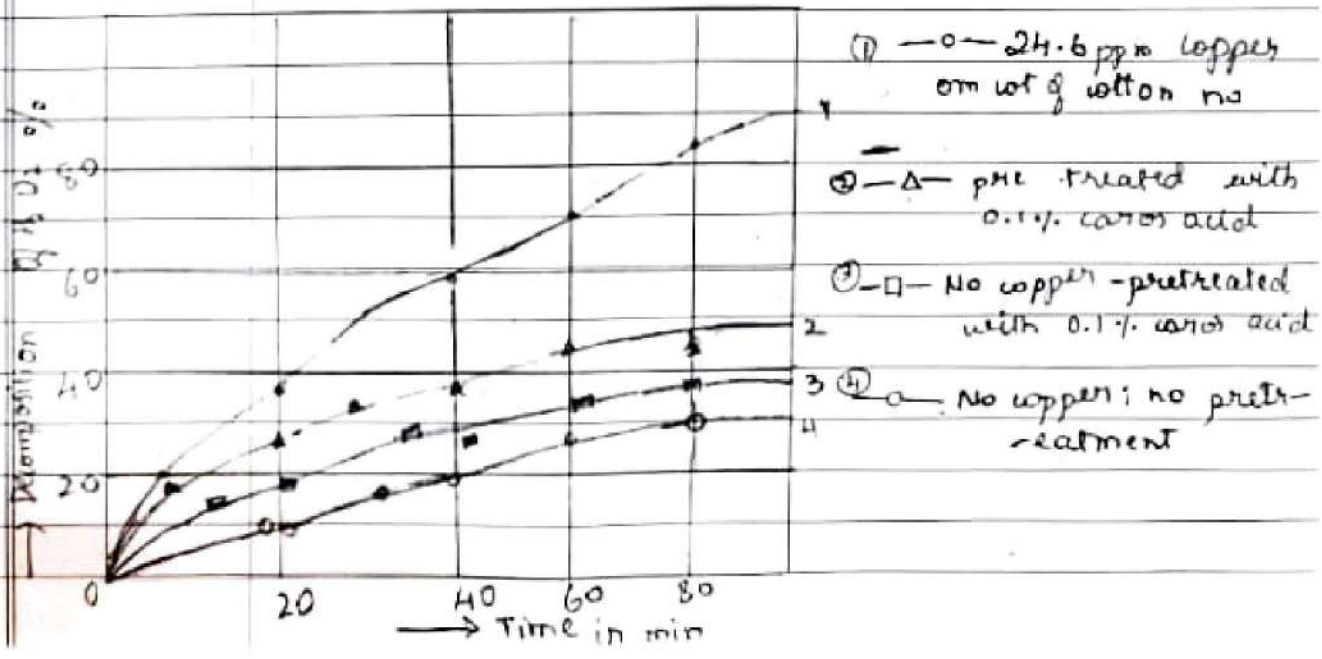
- In practice cotton bleaching is carried at 90-100°C
- Rate of Bleaching increased with increasing temp
- But the stability decreases. [Means decomposition Percentage increases, bleaching action is intensified Sol unstable]
- Below 80°C evolution of perhydroxil ion is slow. So rate of bleaching slows down.

Ex:-

Temp °C	% at commencement	After 1hr	After 2hr.
20°	0.69	0.69	0.69
40°	0.69	0.65	0.625
60°	0.69	0.53	0.39
80°	0.69	0.39	0.18.

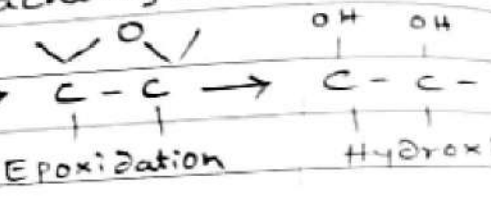
2. Catalysts:-

It is well known that hydrogen peroxide is decomposed catalically by the traces of metals & their oxides. Sketch : SMC Ref : P-17.



Mechanisum of Bleaching:-

1. $-C=C- + H_2O_2 \longrightarrow$ (epoxidation) $\rightarrow$ (hydroxillation)



2. $H_2O_2 \underset{H^+}{\overset{OH^-}{\rightleftharpoons}} H^+ + HO_2^-$ perhydroxil ions.

$HO_2^- + H_2O_2 \longrightarrow \cdot OH + \cdot O_2^- + H_2O$

superoxidation ion & hyper-oxide ion

$C=C \rightarrow$ destroyed by epoxidation & hydroxillation

- Earlier [O] is responsible.
- certain cond: $H_2O_2 \rightarrow$ Hydrogen & perhydroxil $[HO_2^-]$ responsible for bleaching.

Recent; superioxide radical ion $[\cdot O_2]$ - responsible for bleaching.

Stabilizers for peroxide Bleaching:-

The process of regulation or control of perhydroxil ion To prevent rapid decomposition of Bleach & to minimise fibre degradation is described as stabilization.

- control the formation of free radicals: rapid decomposition - over Bleach
- Selection depends on
  Fibre Type &
  Blends.

NaOH, Na_2CO_3 } cellulosic fibres.
Ammonia. protein fibres.

& various phosphates. Ex: Tetrasodium Pyrophosphate
Hexametaphosphate

"Sodium silicate" - conventional, easily available, widely used stabilizer.

From this relation :- The percentage active oxygen can be calculated for peroxide sol

$$x = \frac{47.05 \times c}{100}$$

Properties of H_2O_2 :-

- color less liquid in small quantities. bluish in bulk
- Dil sol - neutral in color.
- Pure H_2O_2 - stable for several weeks.
- contact with rough surface, in presence of gold, platinum, iron - action is reduced.
- H_2O_2 decomposes with liberation of oxygen & Perhydroxil ion.
- Super oxide ions are liberated respectively for Bleaching.

Advantages :-

- costlier than NaOCl. but several advantages.
- Universal bleaching agent, used for cotton, wool, silk Jute --- etc.
- Fabric is less suffered compared to NaOCl.
- Less water is required.
- Souring not required.
- Superior fastness.
- Goods are more absorbant compared to NaOCl.
- H_2O_2 is much safer from the point of chemical degradation of cotton.
- Better than NaOCl for colored goods.
- Less tendency of yellowishness.
- Bleaching is carried out under alkaline condition and high temp, possible. To employ mild cond absorbancy is improved.

Disadvantages :-

- Metal vessels must not be used. ∵ decomposes in Presence of H_2O_2
- Use tap water & EDTA to avoid metal ions.
- Quality of water has to be checked.

PEROXIDE BLEACHING.

Bleaching cellulose fibre with peroxide:

- 1818 - Thenard discovered.
- 1966 Used on Textiles.
- Due to high cost limited use till 1935.
- Hydrogenated water.
- Dil HCl on BaO_2 (Barium peroxide)

$$BaO_2 + 2HCl \longrightarrow BaCl_2 + H_2O_2$$

- Universal Bleaching agent.
- Used on All textile material: wool, silk & Man made
- H_2O_2 carried with raised temp: combines scouring and bleaching.
- High cost: more used, permant white
- Naocl scoured - Proteins are not removed. Form chloramines - Danger.

Peroxide Bleaching:-

Hydrogen peroxide (H_2O_2) is a colorless liquid solu ble in water. It is highly stable under acidic conditions but is unstable as alkalinity increases as shown below.

PH of peroxide..	Stability.
1 - 3	High
4.5 - 5	Good
7.0	Medium
11.5 - 13	Lowest.

Strength of H_2O_2:-

The concentration of Hydrogen peroxide is normally expressed in terms of volumetric volume of oxygen available per volume of Hydrogen Peroxide.

Calculation of active oxygen:-

H_2O_2 on decomposition.

$$2H_2O_2 \longrightarrow 2H_2O + O_2.$$

On the basis of mol wt

$2H_2O_2$: 100% produces (2×16) active oxygen

$$2(2 + 16 \times 2) \longrightarrow$$

Active oxygen % = $\frac{32}{68} \times 100 = 47.05\%$

Molecular wts
O_2 - 16.
H - 01.

H_2O_2 Bleaching:-

H_2O_2 (35%) : 1 gallon
Sod silicate: 1 lb (stabilizer)
NaOH : 1.75 lb } (Activator)
Na_2CO_3 : 0.33 lb }
Trisod phosphate: 1.16 lb.
$MgSO_4$: 0.033 lb
Water : 100 gallons
Temp : 88°c
Time : 45 Min.
Rinse, cold water, dry it.

Bleaching with sodium chlorite: ($NaClO_2$):-

- achived ever increasing peace for cellulosic mtrl.
- active in acidic soln
- ClO_2 (chlorine dioxide) is responsible.
- Versatile used for cotton and its blends.
- Not suggested for wool & silk.
- More expensive than peroxide.
- Fine white powder.

Mechanisum of Bleaching:-

Sodium chlorite is a medium-strenght acid & hydrolyses in water to a limited extent. It is only active in acidic solution: chlorous acid decomposes into chlorine dioxide, chlorate, chloride and oxygen in acidic condition.

$$5ClO_2^- + 2H = 4ClO_2 + Cl^- + 2OH^-$$

$$3ClO_2^- = 2ClO_3 + Cl^-$$

Optimum conditions for chlorite Bleaching:-

PH : 4.
Temp: 85-95°c
Time: 30 min - 6 Hrs
The con of sodium chlorite is 5 g/l in long liquors
~ 20-30 g/l pad batch process
~ 10 g/l - J boxes.

Effect of PH:

2.5 to 3.5 : ClO_2 liberation more rapid.
PH: 4.5 Ideal.

Activator: Formic or acetic acid

H_2O_2 : reduces decomposition & protects stainless steel vessels.

. Rapidly corrode. ceramic lined glass, stoneware & Titanium plants.

Bleaching Process:-

Bleaching liquor may be made up with sodium chlorite (1-2%) and a wetting agent and brought to a pH around 4.0 with addition of acetic & formic acid at 80-85°c for 2-3 Hrs.

Winch M/C:-

Batch processing:-

Suitable: clean yarns.

Recipe: ① Sodium chlorite (80%) = 2-4 g/l.

② sodium dihydrogen phosphate = 1 g/l

③ sodium nitrate = 1-2 g/l

④ wetting agent = 1-2 g/l.

⑤ formic acid to adjust pH = 3.8 - 4.2

Process:- Run the material for 10-15 min at cold, temp is raised to 80-85°c, Time: 1-2 hrs. followed by soaping and washing.

Jig Bleaching:-

- Stainless steel,
- Titanium with valatine lining.
- Enclosed chamber.

Recipe:-

Sod chlorite (80%) : 20 - 30 g/l

Sod dihydrogen phosphate: 3-5 g/l.

Surface active agent : 0.5 g/l

Formic acid to adjust (pH) 3.8

2-4 ends through this liquor

- Drain the liquor

- Steam turned & temp raised to 82°c

- again 2-4 ends

- keep it for rotating: 4-5 Hrs

- Last: Soda ash scald.

Continuos Bleaching (J-box)

The batch process of sodium chlorite bleaching may be uneconomical as compared to other oxidative bleaching agent due to high consumption of sodium chlorite. The consumption reduces significantly in continuous method, based on padding and storing at 95°c for 90 minutes in J-box. Prolonged alkaline scouring is not necessary, as it does not form chloramines as in case of sodium hypochlorite. This avoids the risk of degradation of cellulose & color variation due to varying extent of scouring at different portions of fabric. Thus a uniform whiteness is obtained as compared to other oxidative Bleaching agents.

The cloth is firstly scoured in J-box with 2g/l detergent with or without caustic soda / soda ash followed by washing. The padding liquor may contain :

Sodium chlorite (80%) : 10-30 g/l.
Sodium dihydrogen phosphate : 3-5 gpl.
Wetting agent : 0.5 gpl
Formic acid (pH Maint) : 3.8-4.2

After Emerging from J-box, the cloth is passed through a continuous rope washing machine and washing may be carried out with cold water & hot soda ash scald,

Advantages:-

(a) Pre-scouring & vigarous alkaline treatment can be avoided.
(b) Effectively bleaches lignin present in the woody matter.
(c) Good whiteness is obtained.
(d) Soft fabric handle & good sewability.
(e) Least risk of chemical damage. Suitable for P/C

Disadvantages:-

(a) Possibility of libaration of Toxic chlorine dioxide
(b) Process is expensive.

(c) not suitable for silk & wool (pink coloration)
(d) Neutral & ~~PH of~~ alkaline PH tender cotton.
(e) Chlorin dioxide decomposes < HCl / Cl_2
. Skin irritation
. attack on ~~skin irritation~~ mucosum membra
cause fatal pulmanory edima.

SILK Bleaching:-
Color : Type of worm & Feeding.
Chlrophil, xanthophil & carotin.
- degummed silk: still yellowish - fashion designer.
✓ desired whiteness.
- oxidative or reduction methods, bolk also.
✓ Best H_2O_2.
- Per hydroxil ions for oxidation.

Recipe:- Mulberry silk:-

H_2O_2 (35%) by wt	: 15-20 ml/L
Stabilizer	: 2 g/l.
M:L	: 1:20.
Temp	: 75-80°c
Time	: 1-2 Hr.
PH	: 8.5-9.

Wild silk:-

H_2O_2 (35%)	: 20-30 ml/l
Stabilizer	: 4 g/l.
M:L	: 1:30
Temp	: 80-90°c
Time	: 3 Hr.
PH	: 8.5-9.

Process:-
Degummed silk - Enter bleaching bath at 40°c → alkali NH_3 or tetrasodium phosphate (of bath)
PH : 8.5-9, ~~St~~
stabilizer : sodium silicate
I Stainless steel.
Raise the temp; gradually 80°c, More temp : lower tensi strength.

Bleaching of wool:-

- Approximately 10% of total world production wool is bleached
- H_2O_2 only oxidative bleaching is suggested.
- Hypochlorites - poor bleaching action gives-rise to yellow coloration, tender wool
- Sodium chlorite - pinkish white.

Wool Bleaching important considaration.

1. control of alkalinity: High causes breakdown of poly peptide chain & loss in strength.
2. Temp should not exceed 60°C.
3. Recomonded PH is 8 - 8.5.
4. Iron & copper cause catalytic decomposition Rapid decomposition of H_2O_2 - Tendering wool.

Stabilizers: Sodium silicate.

Bleaching of wool:

There are four methods of wool Bleaching

(a) Bleaching using reducing agents
(b) Bleaching with hydrogen peroxide.
(c) Oxidative/ reductive bleaching
(d) Activated peroxide bleaching

(a) Bleaching with reducing agents:

Reducing agents such as
- Sodium bi-sulphate $NaHSO_3$
- Sodium dithionate

. Use of reducing agent :- relatively limited
. whiteness achived - not perment.
. color of the wool tends to return to air

Bleaching with oxidising agents:-

. wool possesses natural yellow-brown color.
. But some wools are Brown & Black.
. ∴ fibre needs bleaching.
. Oxidising agents : H_2O_2, $KMNO_4$, $NaClO_2$ used.
$KMNO_4$, $NaClO_2$ (Sodium chlorite) - pinkish color needs aftertreatment, not much popular.
. Hypochlorite no bleaching action, cause yellow discoloration.

Bleaching wool with H_2O_2:-

- Most popularly used.
- Whiteness produced - permenent.
- H_2O_2 for cotton carried out at elivated temp
But fo protein fibres: i.e silk & wool: controlled alkalinity and Temp are imp.

! Recomonded Temp & PH is

Temp: below 60°C,

PH : between 8 - 8.5.

catalyst:

Stabilisers:

PH: 8 - 8.5. Too high

- Rapid decomposition of H_2O_2
- degradation of wool, loss of strength Etc

Method of Bleaching:-

- Stainless steel or wooden Vessel.

Recipe:- 2 vol sol of H_2O_2

0.5 % sod silicate.

Stabilizer: Stabilizer C.

Temp: 50°C.

Scoured cntrl — Enter — worked for 20-30 min allowed to stay in a cooling bath for 3-4 hrs & overnight

After steeping, taken out, rinsed, soured with HCl

Bleaching of polyester & its blends:

- 100 % polyester bleaching is done only in exception case where Perfectly White is required.
- Best - sodium chlorite.

Recipe for 100 % polyester:

1. Sodium chlorite : 2 - 5 g/l
2. Sodium nitrate : 1 to 2.5 g/l
3. 85 % Formic acid: 1 to 2.5 g/l (to adjust PH: 4.5)
4. Temp : Near boil
5. Time : 1 to 1½ Hr

Bleached fabric is hot washed, cold rinse, dried.

Bleaching of PIC blends:-

Invariably cotton component is bleached.

Bleaching agents viz:

NaOCl.

H_2O_2 &

$NaOCl_2$ suggested.

Batch, semi continuous & continuous processes used.

Hypochlorite Bleaching:-

Recipe:-

Sodium hypochlorite : 3 g/l. available chlorin.

PH cotton : 10-11

Temp : RT, Time: 2-3 Hrs.

Rope washing m/c: Fabric in rope form.

J-box:-

NaOCl : 2-4 g/l available chlorin.

Temp : RT

Time : 30-60 dwell in J-box.

Peroxide Bleaching:-

H_2O_2 used

- Batch,
- semicontinous &
- continous

In Batch: Jigger used.

Recipe:-

35% H_2O_2 : 3 to 6 g/l.

Sodium Silicate: 3 to 4 g/l.

Caustic Soda: 1 g/l.

detergent : 1.5 to 2 g/l.

Temperature : 90°-95°c

Time : 1½ to 2 Hrs.

Bleached goods - Hot & cold rinsed as usual.

Semi continuous:-

Regular pad roll process:-

Recipe:

35% H_2O_2 : 12 to 20 g/l.

- Sodium silicate: 12-15 g/l.
- Caustic soda : 3-5 g/l.
- Detergent : 3-5 g/l.

Padded fabric - preheater - batched in mobile batching. slowly rotating 1½-2 Hrs. Bleached fabric washed thoroughly.

J- Box Bleaching for P/C blends:-

- Open width
- continuous.

Recipe:

- Hydrogen peroxide (35%) : 2-8 %
- Sodium silicate : 3%
- Soda ash : 0.8 to 6 %
- Sodium Hydroxide : 0.4 to 0.6 %
- Intial PH : 10.3 to 12.0.

Sodium chlorite Bleaching:

- Advantage
- Bleaches both

Batch Process: Jigger.

Recipe:

- Sodium chlorite : 2-5 g/l
- Sodium nitrate : 1.5 to 2 g/l.
- 85% formic acid : 1.5 to 2 g/l. (adjust PH to 3)
- Temperature : starting at 60°-↑near boil - 20 min
- Time : 1 to 1½ Hrs at boil.

Bleaching of viscose/cotton:

- Batch method
- Jig or winch.
- J- box.

Winch:

NaOCl : 2 g/l available chlorin
Na_2CO_3 : PH maintain
Time : 1 Hr.
Temp : 25°c.

J- box continous Bleaching:

Saturate with bleaching liquor con

H_2O_2 and potassium persulphate, passed through J-box followed by short boiling - off.

- Rinse & dry
- Processing time : 15 min
- Temp : 70°C
- Wash liquor : 80°C.

Bleaching of weft knitted cotton goods:-

Knits : wide range of fibres & blends
: Flat or tubular.

Garments: Outer wear
Sports & leisure wear

Warp Knits : 100% filament, synthetic - do not require bleach.

Weft ~~blends~~ Knits: 100% & Blends : Jersy, rib etc.

- comfortable
- light & pleasing hand
- Poor dimensional stability

Knit yarns : Unsized, comber.

Knitting lubricants: replace size, creates foam & stains.

Bleaching of knitted goods:

- ✓ result in high whiteness
- ✓ low chemical & abrasion
- ✓ low crease formation
- ✓ High water absorbency.

NaOCl - not suggested : alkaline.

To be bleached: with NaOCl.

- PH - 11,
- Temp : 30-35°C
- wetting agent. Then antichlor.

Sodium chlorite - suggested (acidic)

Combined hypo | peroxide - suggested - Highest whiteness achived.

Analysis of Bleached fabrics:-

1. Tensile strength of Bleached fabric 15 cm x 3.75 cm in triplicate.
2. Sinking time : sample size : 3.75 cm x 3.75 cm.
3. Capillary rise: (Ht of rise of water) : 15 cm x 2.5 cm
4. Visual examination.

Hypochlorite Bleaching:-

Bleaching time : 15 min.
Temp : 60°C
NaOCl : 1.5 g/ltr available chlorin.

- ✓ Good whiteness:
- ✓ Sinking time : 5 sec.
- ✓ Capillary rise : 9.3 cm ht.
- ✓ Tensile strength & cuprammonium fluidity shows cloth has gone some degradation.

Copper Number:-

To Estimate the degree of degradation: due to oxy cellulose.
It is gms of copper reduced from cupric to cuprous state by 10 gm boiled with Fehling sol^n (copper sulphate $CuSO_4$).

- ✓ Raw cotton - 0.9
- ✓ Pure cellulose - 0.2
- ✓ Well bleached - 0.3
- ✓ Viscose - 0.8 to 1.2.

Cuprammonium Fluidity:-

- widely accepted.
- measure of overall degradation.
- Fluidity is the reciprocal of viscosity
- more for bleached cloth.

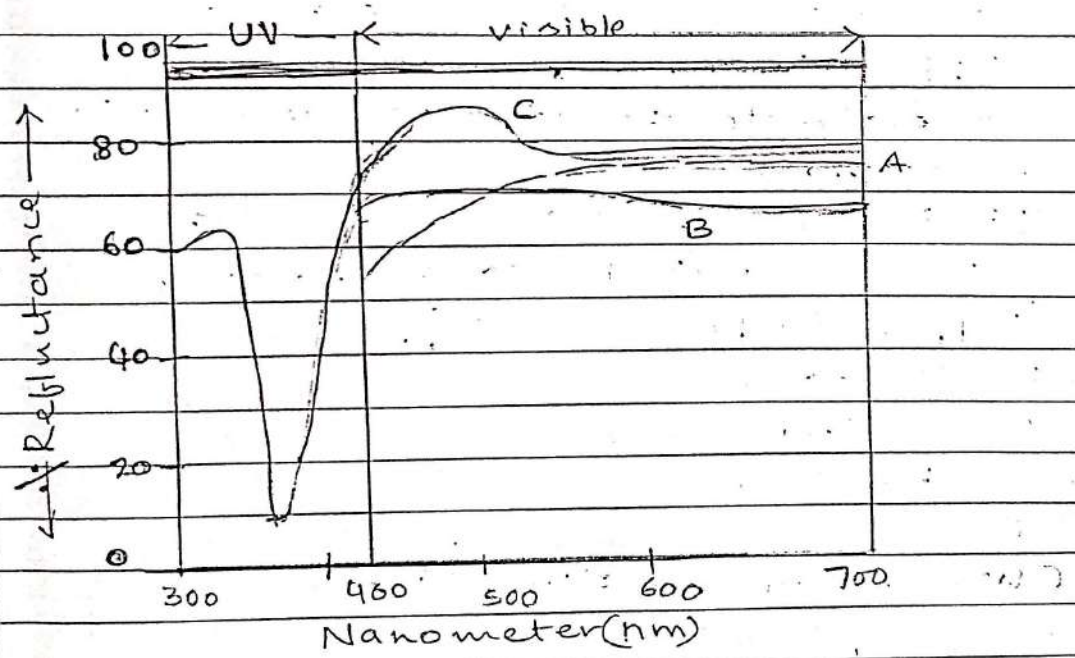
Standards:

1.5 - mild scoured & Bleached
5 - 10 Normal —"—
10 - 20 Strongly —"—
20 - 30 Badly —"—

Optical Brightening Agents:-

- Textile fibres do not perfectly white - colored impu
Bleaching: color impurities destroyed/decoloured
Over Bleaching: reduces strength.
Well bleached also: posses light yellowish appearance
This yellowish hue - eliminated by OBA/FBA
OBA - optical Brightening agents.
FBA - Fluoracent Brightening agents.
Blueing agents are also used.
whiteness covered by bluish dye - bluish white.
OBA - counteract yelloqness by increasing the reflection of blue light rays.

- convert invisible short-wave UV rays of sunlight into visible blue light - degree of whiteness improved.



A - Refluctance of a bleached cloth
B - After adding blue tint
C - After adding fluoracent brightner.
Straight line - 100% refluctaince.
Graph analysis:-
A - Bleached cloth deviates from ideal.
B - Apparently whites (Blueing agent).
C - Treated with OBA - Improves distribution

of the spectral whiteness reflectance (outstanding)

Chemical constituents of OBA:

- Production & consumption increases 10-12% every year
- addition to Textile, detergent & paper industries also used.

Consumption of OBA:

Branch	consumption (%)
Detergent mixture	40
Paper	30
Textile	25
Synthetic fibres & plastics	5.

Also used in

- Brightening of feathers
- Fats
- gelatine,
- wood shavings & sand dusts
- Paints
- leather,
- Furs &
- Photographic industries.

Characterstics:-

- Organic compounds.
- colorless dyes.
- Having conjugated double bond, contain OH, NH_2 etc
- derivatives of Stilbene, Benzadine, Benzothiozol
- 50% OBA derived from stilbene.
- world market more than 2500 trade marks representing 200 varions products.

Mechanisum of Fluoracent whitening:

When a specimen transforms a part of the absorbed light into light of another wavelength instead of into it is called fluorecent specimen FBA absorbs UV light in 300-400 nm region from day light and emit in the visible region (400-460 nm) at the blue-violet of the spectrum The emitted blue light compensates for yellow tin

of fibres and at the same time they also increases the luminosity of goods.

Factors influencing the functions of OBA.

OBA are applied to substrate

- ✓ separate after treatment process
- ✓ added to bleaching / finishing baths.

1. Substrate:-

Brightening effect depend on nature of substrate.

Ex:- cotton - strong refluctance

Viscosed wool - weaker.

2. Saturation:

There is a saturation limit for each OBA. above that: yellow color super imposed & decrease in whiteness.

3. Method of Application:

Exhaust method - Higher whiteness value.

4. Time:

Genarally - optical brightening agents have high rate of exhaustion on the substrate and therefore great care is to be taken to avoid unlevel application. slow exhaustion rate and increased migration is necessary to produce level whiteness on fabric.

5. Temperature:-

Opt temp on cellulosic fibres usually b/n 40° & 60°C

Synthetic fibres: little higher temperature reqd.

PH:
Chemical stability
Solubality &
affinity of OBA depend on eff PH.
Wool & polyamide fibres – acidic side.
Salt:
To promote & control rate of Exhaustion.
Application of OBA:-
The appln of OBA depends on kind of fibres.
classified as.
1. Disperse
2. Direct &
3. cationic.

Disperse:- water soluble
used for polyester, cellulose acetate & polyacrylonitril
Direct:- derivative of 4,4' diaminostilbene-2,
2'-disulphonic acid:
used for cotton, paper, viscose, linen & polyamides
cationic compounds are melkane ethanine type,
used for polyacrylonitrile fibres.
OBA compounds available in
Powders
Pastes
liquid water insoluble forms &
stable dispersion.
OBA for cellulosic fibres:
1. Exhaust method:
OBA : 0.5 – 0.6 % owf.
Electrolyte: 5 g/l.
Temp :
Time : 45 min.
2 Pad method:
Materials are padded with a sol containing
0.05 to 4 g/l OBA
Room temp:

Date
Page

Cotton Fabric:

OBA : 0.02 to 0.2 %.
Acetic acid (30%) : 2 - 4 %
Formic acid (85%) : 1 - 2 % (PH Maintain)
PH : 3-5
Temp : 40°C
Time : 20 min.

Silk Fabric:

After degumming, Peroxide bleaching,
OBA : 0.5 to 4 %
Reducing agent : 2-5 g/l
Temp : 70°C
Time : 45 min.

Polyester Fabric:

No affinity for water solwble OBA.
Exhaust method:
0.5 - 2.0 OBA
1 g/l - dispersing agent
2-4 gm : carrier
Acetic acid - PH
PH : 5-6
Goods run through sol, 40°C : 15-30 min time.
Temp increased - near to boil - Time : 30 min.
Total time : 120 min.

Blended Fabrics:- P/C.

Combined in bleaching Process.
Exhaustion or Pad.
Sodium chlorite : ~~conc~~ - 1.5 % + 1-5 g/l, OBA : 0.5-1.5%
acetic acid : To maintain PH owf
PH : 4.
Drain out & then OBA application.

MERCERISATION.

Introduction:-

- Imp for cotton & its blends.
- John Mercer 1850 England.
- Lowe England 1890 patent.
- Treat with NaOH of 25% conc
- cotton cellulose + NaOH → Alkali cellulose.
- $C_6H_9O_4-OH + NaOH \longrightarrow C_6H_9O_4-ONa + H_2O$.
  cellulose. alkali cellulose.

Changes made:

- ✓ Improved lustre: c/s round, : reflection of light is more
- ✓ Improved dyability: surface area increases.
- ✓ Improved reactivity with variety of chemicals
- ✓ Improved Strength & Elongation: Structure becomes uniform & overall Str↑
- ✓ Improved dimensional stability:
- ✓ Smooth & Improved handle.

Less attractive:

- Increased cost of chemicals
- Machinery
- Labour
- Effluent control
- Recovery of NaOH. – Make the process less attractive.

Methods:

1. Slack mercerisation / Tension less.
2. Tension / Taut.

Slack – cotton hairs looks flat thin ribbon looks like rod.

Tension: appears perfectly cylindrical. – lumen contracted at central part slig

Mercerisation:

- Gray & after scouring / bleaching.
- Singed – smooth surface.

- commonly after scouring.
- If bleaching plant available – continuous

Chemicals used:-

1. NaOH.
2. KOH.

conditions:

- Application of NaOH : 55°-60° TW (30%)
- Temp: Room temp.
- Time ; 55 sec an avg.
- warp way tension; widlt way also.
- Wash - till alkali removed.

(2) KOH:

cloth → padding m/c, KOH : 60°-70° TW at RT → one min → dil H_2SO_4 (neutralise) — wash — run-SQ.

changes in the physical property of cellulose due mercerisation.

1. Chemical: Formation of alkali cellulose
2. Physio-chemical: changes in the arrangement of units of cellulose.
3. Structural modification: str becomes round.

Modification depends on:-

- Proper concentration
- Time
- Tension & Temp.

Structural changes Taking place during mercerisation.

1. Swelling and shrinkage: associated
→ Molecular attraction due to hydration.
→ Osmotic phenomena.
→ when immersed in NaOH, water & alkali diffuse
→ fibre quickly starts untwist, from twisted str
→ becomes cylindrical rod.. deconvolution.
- c/s diminishes
- dia round.
- cylendrical surface; reflect more light
- fibre more lustrous.
- fibre shrinks length-wise.
- Optimum cond: contract nearly 9% in length

and swell nearly 150%.

Effect of alkali Metal Hydroxides on the swelling of cotton fibre.

Reagent	con of alkali: g/100g	Mole/l	Increase in
LiOH	9.5	4.0	97
NaOH	18.0	4.5	78
KOH	32.0	5.8	64
RbOH	38.0	3.8	53
CsOH	40.0	2.7	47.

Max swelling con of diff alkalies depend on degree of hydration of alkali ion.

- small con of alkali: dia of hydrated ions is less large to penetrate into mol str
- But as con increases: no of water mol available for formation of hydrates decreases.

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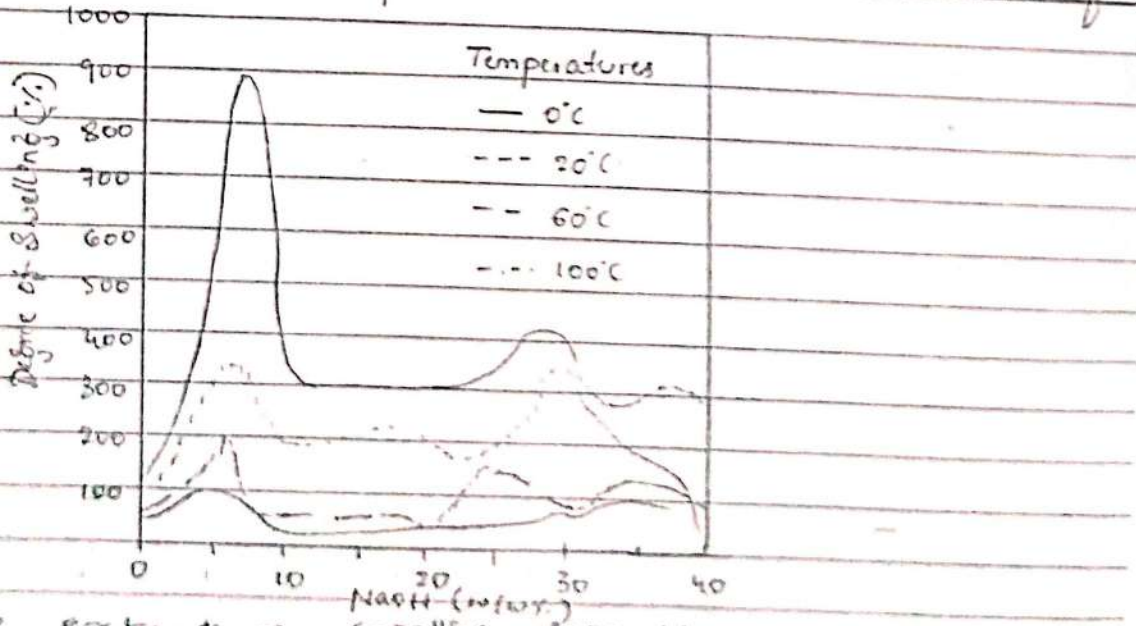
Dependance of swelling on temperature & con of alkali



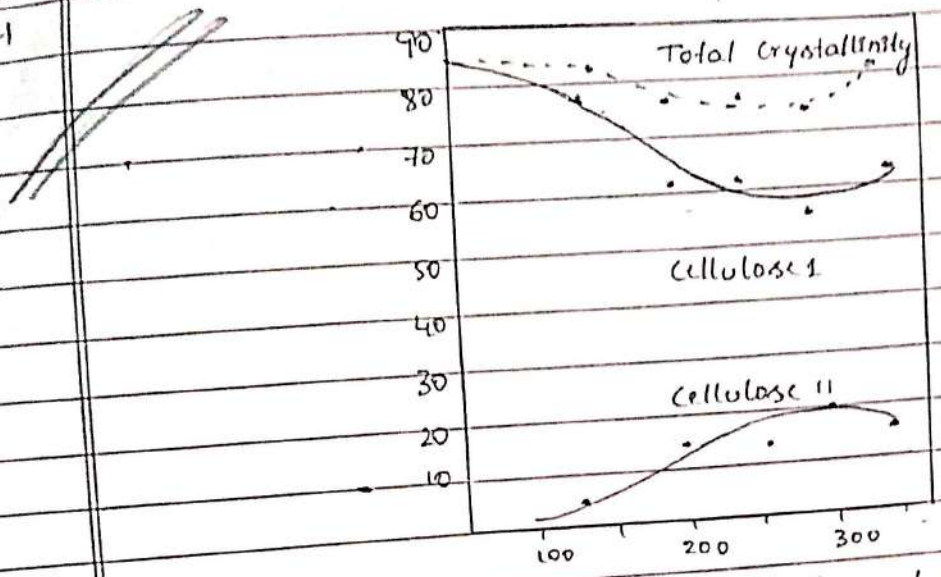
The extent of swelling depends on con of alkali

- At 20% Increasing con of NaOH at 20°C, swelling Max
- Next it decreases

Though 5% gives max:

- commercially higher con of 31-35%
- It is only preferential absorbtion.

2. Structural modification:



Influence of NaOH conc on the crystalline structure of cellulose fibres.

- Dne to swelling many hydrogen bonds break.
- Mol chain move apart.
- Mol structure become decrystallised
- chains structure more uniform.
- Better orientation.
- weak spots removed. (small irregularity. fibre become round)
- fibre - straight rod.

3. Increased lustre:-

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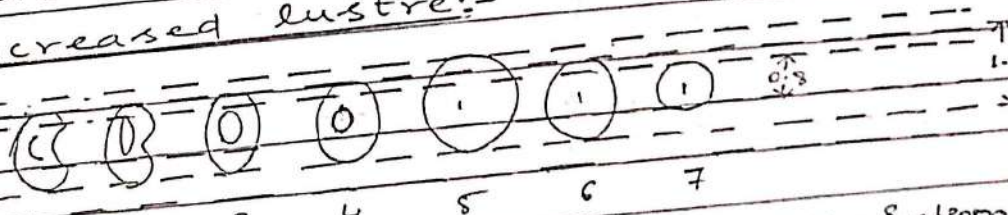


Fig - Seven successive stages of change in the cross-sectional shape of a cotton fibre as produced during mercerization.

Unmercerised: Flat ribbon with spiral twists
: rough & non uniform surface.
: irregular c/s
: Ear shaped
: broad lumen, irregular.
: Becaus of all : less lustre.

Mercerisation ✓ cellulose begins to swell
✓ becomes circular.
✓ lumen practically eliminated
✓ untwisting takes place.

changes in the last 3 stages:
- Same shape; but shrinkage proceeds.
- To secure good lustre: shrinkage must be prevented.
- Yarn lengthwise; Fabric: both length & width.
- Without Tension: smoother, rounder, no twist.
: shows creases & wrinkles
: No appreciable increase in lustre.

Lustre increases as tension applied.

Lustre depends on:-
✓ axial reduction
✓ light scatter ↑, lustre increases.
✓ Temp increases lustre increases, faster & Uniform Penetration.
- Short fibres: decrease lustre
- long staple: Best, cross section good.
- Twisted: More.

4. Gain in strength:-
Mercerisation both slack and tension: Increases the strength uniformity, along the fibre length.
But with tension: greater gain in strength.
- weak points eliminated.
- cohesion increases.

Physical Properties:-
✓ Youngs modulus increases ∵ increased orientation
✓ Twist is important.
✓ Gray yarn with soft twist - Max strength increase

5) Incresed dye absorption:-
✓ Mercerised cotton shows
ⓐ Increased depth of shade, increased rate of dyeing and irregularities due to neps reduced
ⓑ Modification of fibre size and shape

. increased amarphous region.
. nearly half of the dye stuffs
. change in pore volume & reduction in lumen size.

5. Increased moisture absorption:-
Mercerised cellulose
. absorb more water
. Higher regain &
. more easily wet-
Reason;
. NaOH penetration - many hydrogen bonds breaks.
. available hydrogen gronps increased by 25%.
. Decreases crystalline part, increases amarphons content.
Standard cotton has Mc - 7%
Mercerised - 9%, - 11%.

6 - Increased Reactivity:.
. 1½ times increased,
The reactivity ratio increased, ~~inc~~
increases: dye absorption,
✓ moisture absorption &
✓ chemical reaction.

7. Removal of Immature cotton.
removes immature fibres to obtain level dyeing properties.
Dead fibres - flat, twisted tapes.
non crystalline, thin cell wall, collapsed lumen.

8. physical compactness:-
. Improves Dimensional stability.
. Bleach then mercerised: More dense.
. Moderate improvement in crease recovery.

Important factors involved:-

1. Mercerisation without tension - Gives no lustre
small tension — increase in lustre
2. Max lustre - when tension is sufficient
3. Lustre obtained by - impregnation & washing
4. Max lustre: Impregnation, wash, loosed stretch
5. Long staple cotton produces - highest lustre

Mercerizing Machineries.

- Carried out in the cloth form & hank form.
- Mainly two systems.
- Chain Mercerization: For cloth in open width form
- Chain less type.
- Yarn mercerisation.

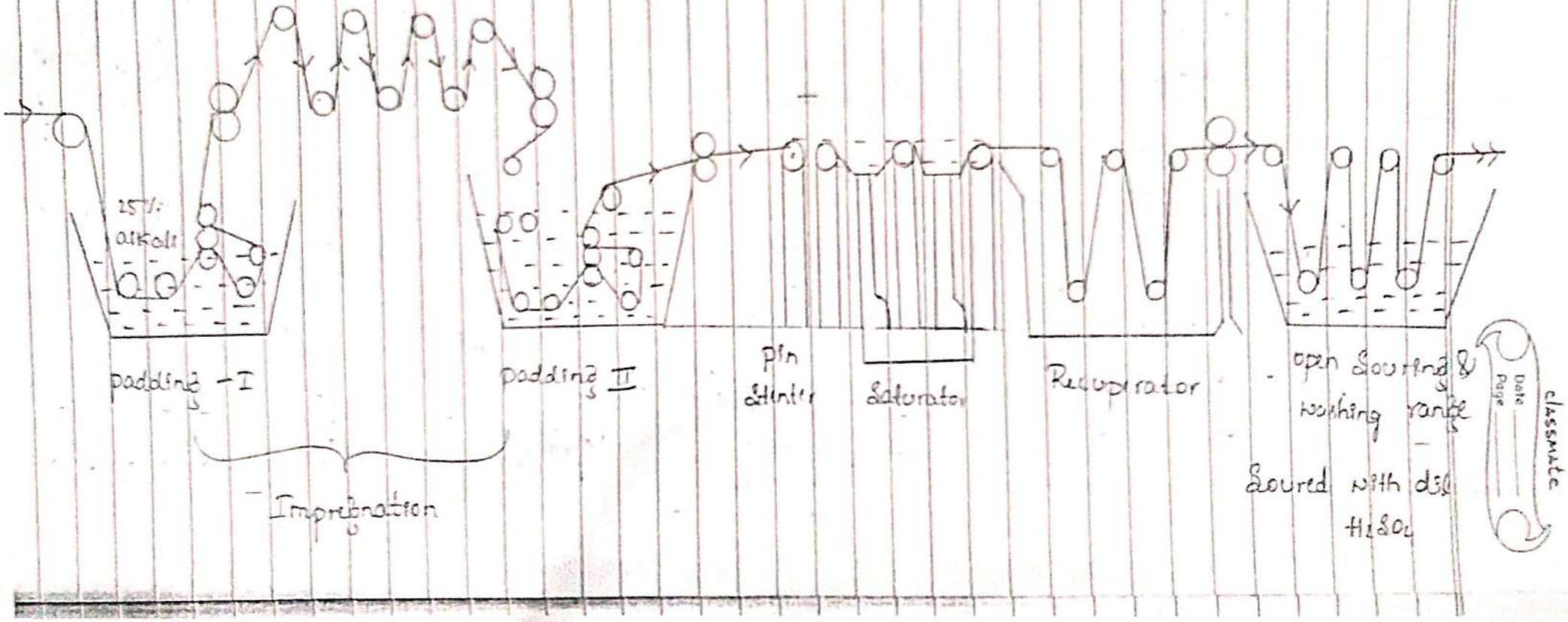
Mercerising machines: 4 sections

1. Mercerizing section: Impregnation with NaOH.
2. Intermediary SQ aggregate: Dividing off mix section against stabilizing section.
3. Stabilizing section: Water treatment & thinning down concentration
4. Intermediatory SQ aggregate: Dividing off the stabilizing sec against washing.
5. Washing section: Wash off alkali.

Cloth Mercerizing machines:

Chain Type:-

- Shrinkage first, Tension later.
- Impregnation con NaOH: 2 or 3 bowl padding.
- Pressure 10-25 tons
- 2nd mangle more pressure.
- Warp tension indicator.
- After 2nd stenter - travel 20ft. stretched con
- Alkali rinsed.
- Each side: Vaccum extractor
- Wash - stentey
- compensating roller: Regulate the tension.
- Steam chamber: Residual NaOH dissolved.
- Squeezed and steamed.
- 7-8 washes. Na_2CO_3 & acetic acid (Neutralizing)


25% alkali
padding - I
padding II
Impregnation
pin stenter
Saturator
Recuperator
open Souring & washing range
Soured with dil H2SO4

- Length : 107 ft (chain length - 50 ft)
- Width : 14 ft
- Production 55 mpm.

Disadvantages:

1. More stretch near selvedges than body.
2. warp density reduces.

Chain ~~loss~~ Mercerisation:-

In this type of mercerisation machine shrinkage is allowed in the primary stage of the process and tension is applied in the later stage to bring the material to original dimensions. The cloth is impregnated to cold solution of concentrated caustic soda by passing through 3 bowl padding mangles. Pressure of 10-25 tons is applied and more pressure is applied on the second mangle. In between the padding mangle the cloth is passed over timing drums to allow strongh action of alkali on the cloth. Due to higher speed of second mangle only warp tension can be applied on the cloth & tension indicator is fitted on to drums. On leaving the second mangle, the cloth is led to open stenter frame for applying tension both in the warp & weft direction. After the cloth has travelled 20 ft in a stretched condition alkali is rinsed from the fabric by overflowing water from a series of cascades. Beneath each of cascades, vacuum extraction slots are mounted so that as the rinse overflows it is immediatly vaccumed from the underside of the fabric. The washing on the stenter can be carried out in a counter current system. The residual alkali concentration should not be more than 8%.

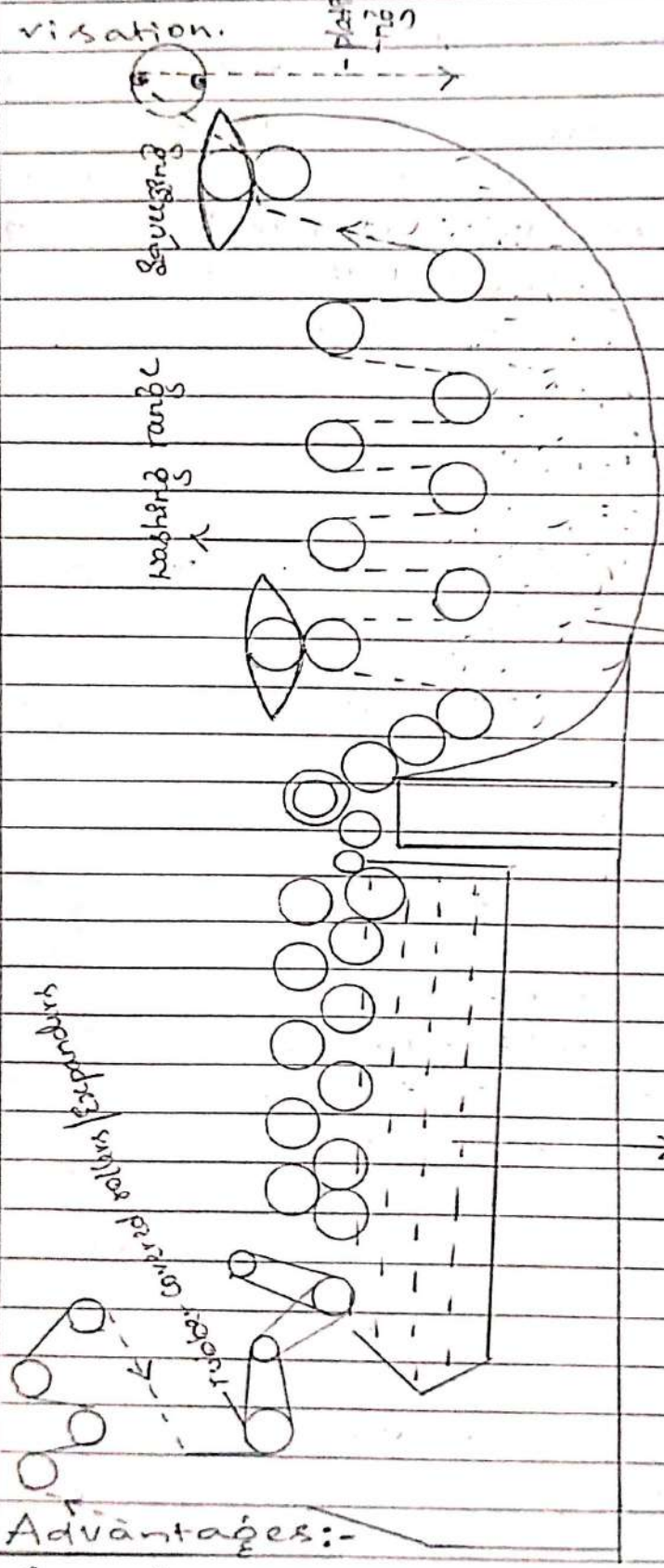
on the cloth. After leaving the stenter the cloth passes over compensating rollers which regulate the tension. The cloth then enters the recuparator or the steaming box divided into series of compartments. The residual NaOH is dissolved under the action of steam and caus-tic is collected at the bottom of each compart-ment. The cloth is squeezed and washed by a series of 7-8 washers followed by neutralising washer using either Na_2CO_3 or acetic acid. The whole range is about 107 ft long with a stand-ard chain length of 50 ft. The width of the range is 14 ft. Production of this machine is about 55 m/min.

Benninger chainless Mercerising machine:-

In the chainless mercerising machine the fabric is pre stretched, tension is maintained till the mercerisation and after washing are completed. The cloth enters the padding step exactly in a similar to that of chain type. The cloth after padding with mercerisation liquor is passed through specially curved and specially dim-ensioned expander rollers which make possible an even expanding effect over the whole width. The expanding depends on the diameter of the roller, the curvature of the roller as well as the angle of warp. The expanding zone consists of a combination of 5- curved expander rollers and four driven cylendrical rollers.

Washing takes place only after the cloth has passed over the first rollers. Normal shrinkage takes place in the washing department. The cloth content in the mercerising compartment is larger and space utilization is less compared to chain mercerisation. Generally hot water is used for wa-shing and neutralisation steps carried in a

similar manner mentioned in the chain mercerisation.



Sketch Chainless

Advantages:-

1. Less floor space requirement
2. More production
3. Two/Three cloths superimposed & increased o/p.

Mercerisation of Ramie and Flax fibres.

Flax fibres generally possess a high degree of lustre and mercerisation is done to improve the affinity of dyestuff, assist in the crease resisting process, improve abrasion resistance and cover the readiness in cloth associated with yarn unevelness.

Mercerisation of Blended fibre fabrics.

1. Polyester | cotton : To improve lustre of cotton.

Recipe:-

Temp : RT

Time : 90-120 sec

con : NaOH (42° TW)

2. Polyester | Viscose or polyester | polynosic compon-ents

- Not mercerised.

If mercerised: Spl precautions required.

Recipe:

Temp : R.T.

NaOH : 9-10 % by wt

Yarn Mercerisation:-

- Hank form.
- M/c : Single & double sided
- Capacity : 5-10 kg | batch.
- Mfr : Mather & Platt, Berlinger, Klein, Wefer, Noubold, Jaeggli.

Yarns for

- Sewing threads
- Embroidary &
- Lace goods.

Process:-

Stretched & lowered into NaOH (26-30%)

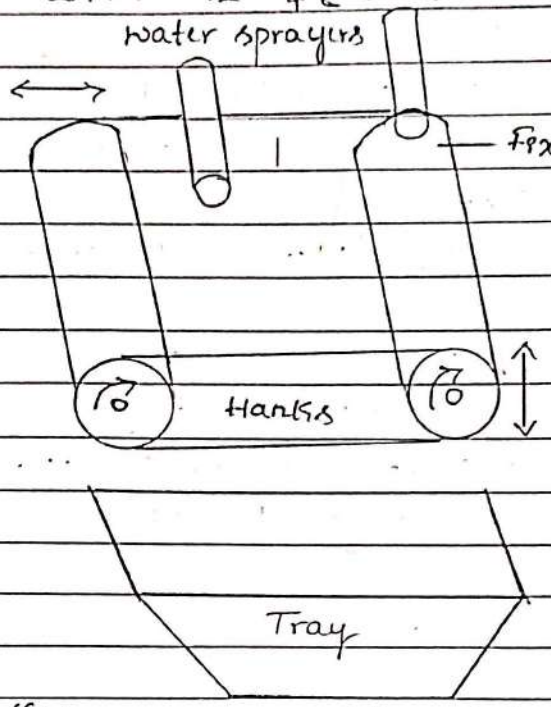
Time : 3-4 min.

Temp : RT.

- allowed to shrink on immersion - Facilitate to liquor to penetrate
- Later tension is applied.

✓ Squeezed and washed under tension: warm & cold.
✓ Soured with H_2SO_4 (neutralise) with NH_3, dried.

Hank/yarn



"Hank Mercerising Machines"

Hot Mercerisation:-

Mercerisation: NaOH at 60-70°c
✓ conventional: T: 15-18, 30% NaOH, 60-90 sec.
✓ cotton swells fast: outer edge density fibre increas further swelling difficult.
✓ Non uniformity.

Hot mercerisation: 60-70°c.
1. Slow swelling.
2. outer edge density is not increased.
3. Viscosity is low.
4. Penetration is more.
5. Diffusion is fast; less time; 20 sec.

Process:-
- Saturate with NaOH.
- Temp: 60°-90°c
- Time: 4-60 sec.
- controlled hot stretching: 2-20%
- cool below: 25°c.
- wash.

Two methods:-

I Method:-

ⓐ Saturation with NaOH, at 60°c & boiling temp 4-60 sec: (Relaxed cond)

ⓑ 2-20% controlled stretch.

ⓒ cool it near 25°c. complete swelling.

ⓓ Washing: (Tension)

ⓔ Final washing: (Normal cond, without tension)

II Method:

- Wash the fabric at 95°c.
- Hot sq with steam inject.
- Hot fabric: impregnate in NaOH sol at 30°c 2nd sleep 20°c (under tension).

Advantages:-

1. Level and uniform mercerisation (due to rapid penetration)
2. Shrinkage is half (at higher temp)
3. Less production cost.
4. Fabric structure more pliable & less-elastic.
5. Higher tensile strength [∵ greater deg of stretch greater orientation, increased cohesion]
6. Better wet-crease recovery.
7. Uniform application of dyes.
8. No wetting agents required [Reduced prodn cost and pollution load).

Liquid Ammonia Mercerisation:

Introduction:-

Introduced 1960, English firm 'coats'

For yarns:

- Sewing threads
- Spl fabrics such as Denims,
- Carduroys.
- Chambrays
- Pillow materials
- Near boiling temp of liquid Ammonia.
- NH_3: Penetrates easily. Unique its swelling.

Flow chart.

Yarn from supply PKg

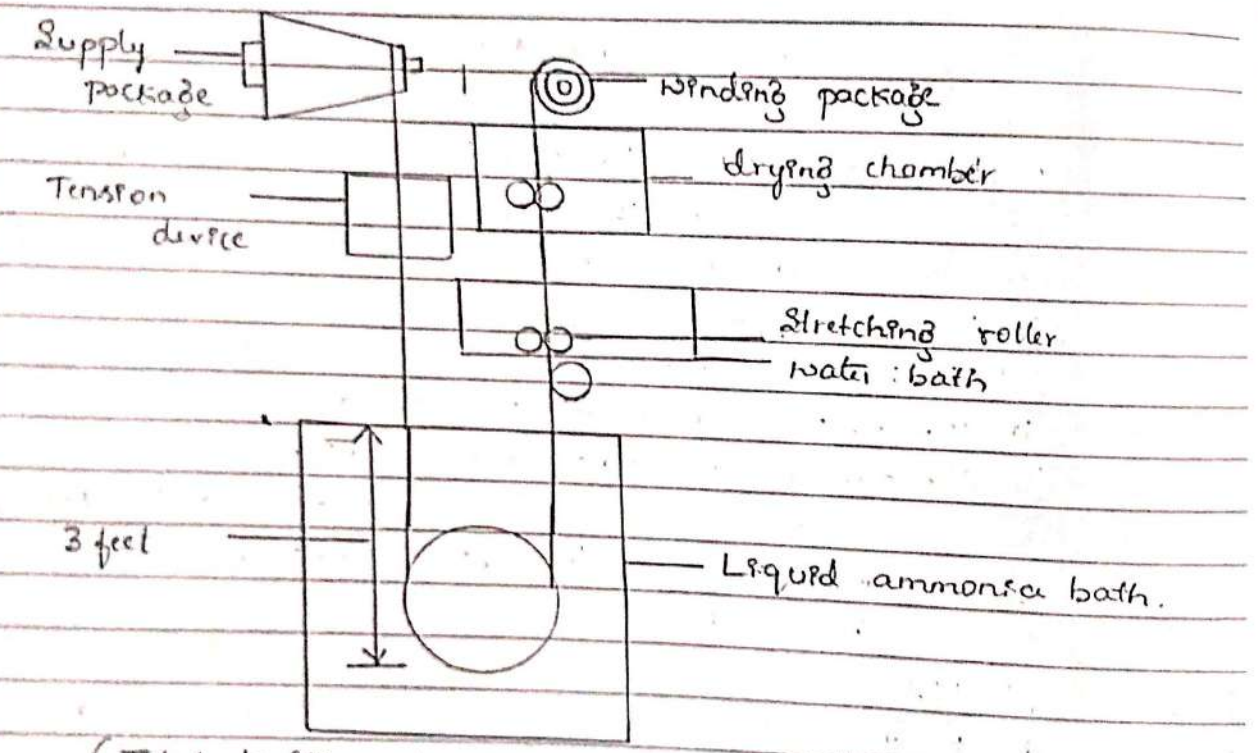
Tension device

Passes vertically down to liquid NH_3 bath (-33°C)

Stretch in water bath (NH_3 removed)

Drying chamber. (Hot air) under tension).

Fig not in syllabus



(Total length of the passage 56 feet)

- Total time of the fabric in the liquid NH_3 is approximately - ½ - ¾ secs.
- Stretching and stabilizing in hot water at near boiling point

Fabric: Liquid ammonia is used as a pretreatment process for

- Shirts, Blouse & dress materials.
- Fabrics: 100% cotton & Easy care finish.

Process: fabric is impregnated with liquid ammonia at -33°C for 10 seconds

Ageing of the fabric under controlled tension for 3-9 min

Drying of fabric using indirect steam heating.
- Recover and re-use of ammonia.

Properties of liquid ammonia:-

1. Solidification temp : -77.7°
2. Boiling temp : -34.4°
3. Specific gravity g/cc : 0.817
4. Surface tension dyn/cm : 34.39.
5. Dielectric const (-34°c) : 32
6. Refractive Index : 1.325.

Advantages:-

(a) Good care properties: (wash, wear, dimensional stability)
(b) Enhanced dimensional stability.
(c) Soft & smooth, flexible
(d) Increased lustre.
(e) Resistance to thermal degradation increases.
(f) High resistance to ageing (storing)
(g) Increased moisture absorption.
(h) Increased dye absorption.
(i) Penetration of liquid ammonia NH_3 into fibre & its elimination are instaneous. Treatment is fast.
(j) NH_3 is recoverable.
(k) Water consumption is reduced to less than half.
(l) NH_3 is natural & process is eco-friendly.
(m) It gives re-agent free Textiles goods.
(n) Fibre damage is much less compared to NaOH.
(o) Mechanical properties like abrasion resistance, tensile, tearing are improved.
- 40% in tensile strength
- 23% increase in elongation at break.

Comparison of various swelling process.

Characteristics of swelling process	Mercerisation	Hot	Liquid NH_3
	conventional		Liquid Ammonia
Speed	Relatively low	fast	very fast-
Degree.	High.	decr with Temp	less than Nacl
Evenness	Uneven in tight	Good	Good.
Shrinkage force	A small shrinkage force & Good extensibility		High, diff in maintaining dimen
Properties:			
Lustre	Large increase	Increased	Improved.
Dye-uptake	strongly increased	Not quite high	30-90% com pared to conv
~~Strength~~			
Strength.	Improvement in the treatment of yarn & Knit goods, more in fabric. Similar in all metho		
Dimensional stability:	Similar eff by all methods, Heavy & Tight fabrics NH_3 advantage.		
Resistance to deformation	stiff & harsh	some what softer.	Similar to hot mercerisatio

Determination of Degree of Mercerisation:-

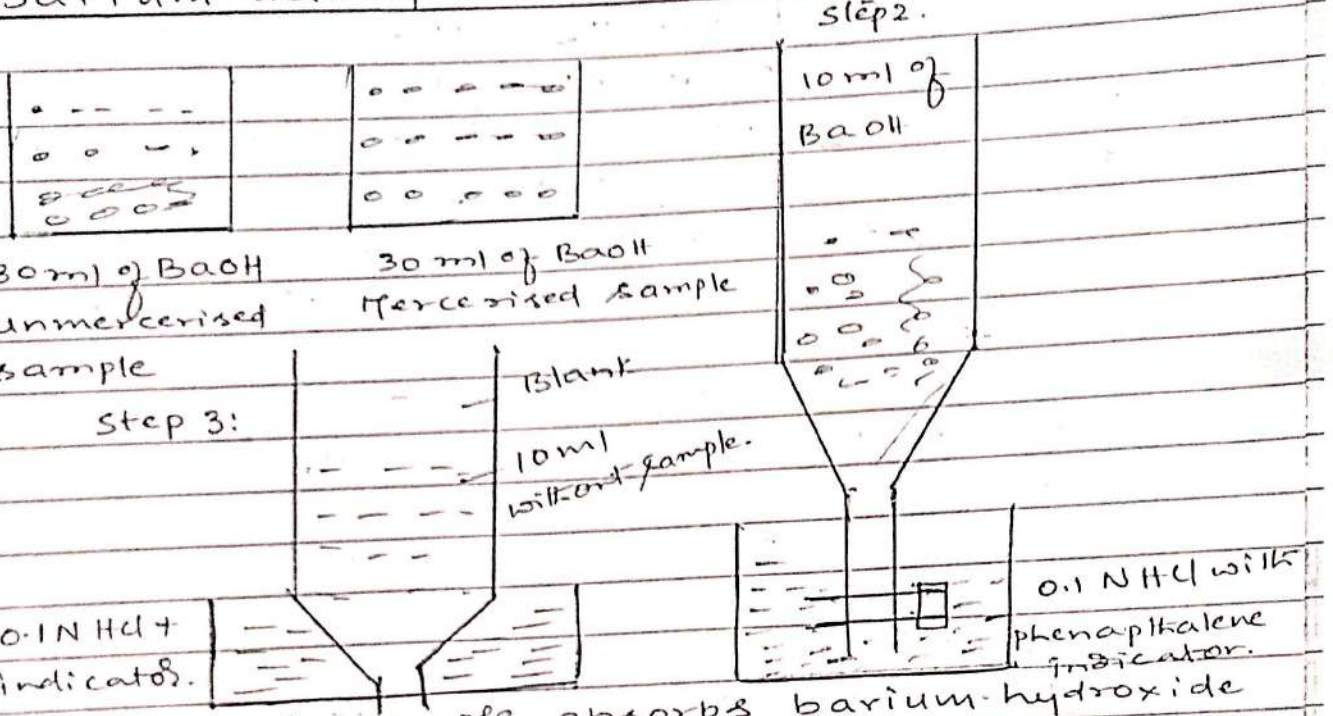
The effect of mercerisation depends on conditio of mercerisation. Quantitative assessment of degr of mercerisation is carried out mainly in three different ways.

1. Variation in the mercerised product
2. External appearance (lustre) &
3. Internal appearance (X-ray)

(1) Determination of Deconvolution count:

In this method cotton hairs are cut in large no of hair fragments 0.2 mm long. They are then mount ted in liquid Paraffin on a microscopic slide, and the counted the proportion of fragments free from twist- on convolution during mercerisation. Deconvolution count of unmercerised cotton is never zero. The figure is expressed as percentage and is called deconvo lution count. If the figure is above 20, the fabric is mercerised. [Out of 100 fibres of 20mm. If 20 fibres have no co volutions, it is better mercer

(2) Barium activity Number (BAN):-



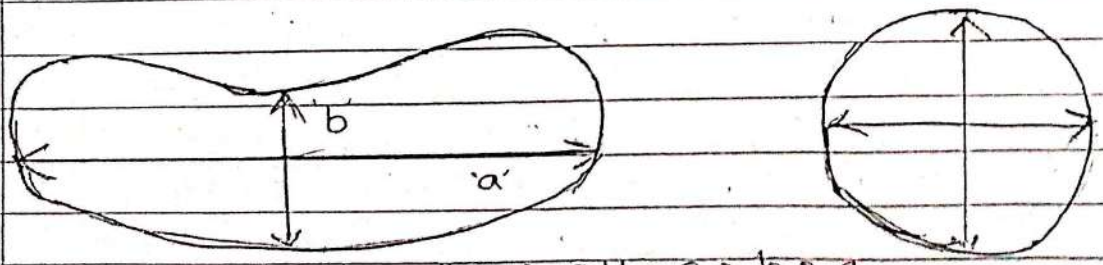
Mercerised sample absorbs barium hydroxide to a greater degree than sodium hydroxide. 2 gm mercerised and unmercerised samples are placed separately in two conical blask containing 30 ml of N/4 BaOH and left for 2 hr or overnight. 10 ml of clear sol is withdrawn and titrated against N/10 HCl using phenopthalene as indicator. A blank sol is carried out on the measured BaOH sol using Methyl Red as indicator.

$$BAN = \frac{b - s}{b - u} \times 100$$

b = ml of required for blank test
s = ml required for mercerised cotton
U = ml required for unmercerised cotton.

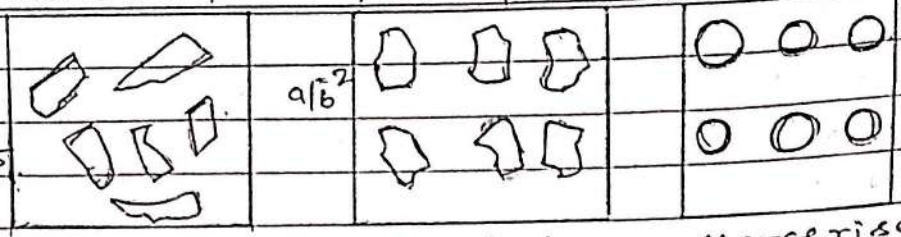
Well mercerised cotton BAN is the range of 150–160.

(3) Axial Ratio:-



Unmercerised cotton: a/b = 2.2 to 2.9

Unmercerised partially mercerised well mercerised.



Raw cotton, low lustre High lustre Mercerised cotton.

The cross section of mercerised cotton observed under microscope. The obeservation shows, c/s of cotton changes from elliptical/kidney shaped to circular form due to mercerisation. This can be measured as a ratio of 2 axes a&b which are called as major and minor axis respectively. 'a' is generally larger than 'b' for unmercerised cotton.

Ratio a/b - ranges from - 2.2 to 2.9. Unmercerised

Reduces to - 1.6 for Mercerised cotton.

Other Tests:-

(1) Measurement of dye uptake of mercerised yarns and fabrics.

Determining K/S value using spectrophotometer: Bolt reluctance as well as absorbance photometer.

K/S: Higher the value higher the dye uptake.

(2) Using reluctance spectrophotometer it is possible to measure brightness index, yellowness index, and whiteness index to understand level of whiteness & brightness of mercerised sample.

(3) Mercerised yarns & fabrics can be tested on Instron tensile tester for any improvement in strength.

Conservation of Energy and Water.

Water consumption in Textile Industry:-

Textile Industry is a leading consumer of water and it ranks among top Ten water consuming Industries.

Water consumption by Textile Industry in various Process.

Sr. No. Substrate	Water consumption kg/kg of Fabric
Cotton	250-350
Wool	200-300
Nylon	125-150
Rayon	125-150
Polyester.	100-200
Acrylic	100-200.

Cotton fibre requires the largest amount of water for its preparation.

Water consumption:

Process	Water consumption % of total %
Bleaching, Finishing.	38 %
Dyeing	16 %
Printing	0.8 %
Boiler House	14 %
Humidification (EPG)	06 %
Humidification (WVG)	06 %
Sanitary, Domestic, etc	09 %.

Water consumption in process house is about three times the consumption of all other put together. Water consumption is highest. Conventional preparatory process of textiles namely desizing, scouring, Bleaching and washing are highly water consuming operations and consequently energy-intensive

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Consumption of water and energy in Kiers & J-Box

Processes:-

Process	consumption of water (l/kg)	consumption of steam kg/kg
Desizing.	3	0.25
Washing.	20	0.35
Scouring.	02	1.75
Washing.	20	0.30
Bleaching.	02	1.00
Washing.	40	0.60
Total	87	4.20
Conventional Kier Boiling	100	5.10

Impurities in water:-

The quality of water to be used in a process house decides the ultimate quality of cloth whiteness, brightness of color etc. The main impurities in water are turbidity and color, Iron and manganese, alkalinity and hardness. color and turbidity in water may stain fibre. Impurities in water may deactivate the enzymes during desizing. Ca, Mg & salts of Ca, Mg deposited on the fabric can affect handle, sewability knithability and water absorbancy.

The quality of water is judged by total dissolved salts (TDS) & hardness which is generally varies depending on the locations & regions.

Acceptable water content for processing:

Impurities:-	PPM
Silica	0.5 - 3
($CaCO_3$) TDS	0 - 25
($CaCO_3$) Total alkalinity	35 - 64
Dissolved solids (TDS)	65 - 150.
Iron, Cu, Mn	Transparent
Turbidity	clear.
PH	7 - 7.5.

Water purification:-

Demineralised or reverse osmosis technique is needed for removal of TDS from water but

costly. Water purification in the process house normally consists of floculation sedimentatio filteration and Iron exchange.

Hard water is softned using one or combination of methods mentioned below:

1. Soda - alum process.
2. Lime - soda Process.
3. Base - exchange process

Economy through Energy conservation :-

The Textile Industry consumes bolk electrical and thermal energy.

All four energy sources i.e: coal, Electricity, Oil and gas are utilized. Power from hydro-electric, nuclear and natural gas also contribute important source of energy.

About 55-60 % of energy consumed in Textile industry is used in various pretreatment process

Technological advancements have been wihi witnessed over the last- decade to meet the challenges for conserving bolk thermal and Electrical energy.

Some of the important approaches:

① Efficiant generation of Energy & Min consumption

② Mechanical removal of water before drying.

- Vaccum roller extraction : 75 % fuel savings
- Expansion of air from fabric for better and uniform impregnation : Use suction slots.

③ Increased eff of drying and Heat setting:

- Thermal insulation.
- Reduced leakage.
- Proper steam lines.

④ Reduced liquor to material ratio.

- V- shaped troughs
- semi & continous operations

⑤ Efficiant Heat recovery

- Heat exchangers.

⑥ Heat recovery from process effluents.

II Economy through water conservation.

1. Minimising liquor to material ratio.
2. Minimising wash liquor
3. Re-using rinsing bath water.

Wet processing of knitted goods.

- Wet processing is almost similar.
- knit goods are too soft to bear any undue tension during any stage of processing.
- Hence m/c are used for woven fabrics are not suitable for knit goods

The processing of knit goods can be carried out in two forms.

1. Tubular form.
2. Open width form.

Flow chart for tubular form.

Fabric reversing
↓ scouring
↓ Bleaching
↓ Dyeing
↓ Finishing
↓ Hydroextraction
↓ Drying
↓ Raising
↓ calendering
↓ compacting
↓ Printing

Note: Mercerisation can be done before fabric reversing.

In open width form:-

↓ After Hydro extraction
↓ Exhaustion
↓ Detwisting
↓ slipping
↓ Drying
↓ Finishing
↓ printing.

Reversing is to avoid soiling during wet processing
In India 90% knit goods processing is carried on winch dyeing m/c.
some limitations of these m/c soft blow m/c are now use.

Soft flow:

- Circulating the liquor through jet nozzles.
- Both fabric & liquor are moving.
- Less tension is given to fabric. There by creases, curling, shape retension are maintained.
- These ensures level dyeing properties and energy savings.