UNIT- II

BLEACHING

* Bleaching:

→ All the impurities can be removed in scouring process.

→ But the natural colouring matter cannot be removed.

→ This coloring matter is removed by bleaching.

→ there are 2 types → oxidising bleaching agent
→ Reducing bleaching agent.

• Reducing bleaching agent:

→ It helps to remove the natural coloring matter.

→ But it brings back the original state of natural color • when it has contact with air.

→ In past, it is used for wool & silk.

• oxidising bleaching agent:

→ This gives more permanent white to the material.

→ Today, almost all textiles bleached by this method.

* The source of the color:

→ The source of the natural color may be

- Flavone (Base) pigment incase of cotton. [Reason for that coloring matter
- soil of dirt acquired from atmosphere.
- contact with plant parts or seeds.
- colors acquired during mechanical processing (oil, grease

* objectives of bleaching:

→ It is to destroy the natural (or) acquired color to bring the textiles in a white state.

→ This may be necessary when:

- Fabric has to be supplied in white colour.
- It needs to be dyed in pastel shades.
- it needs to be printed.

→ Dyeing unbleached fabric in pastel shades
  • Reduces the brightness of the fabric.
→ Bleached fabrics given treatment with optical brightening agent.
  • This confers extra brightness to the fabric.
→ It also removes residual impurities left by
  • desizing, scouring etc.
→ It also increases the absorbency of the fabric.

* Main bleaching agents:
→ The main bleaching agents are
  → Sodium hypochlorite (NaOCl)
  → Sodium chlorite [$NaClO_2$]
  → Hydrogen peroxide [H_2O_2]

BLEACHING WITH SODIUM HYPOCHLORITE:
→ It is necessary to remove natural colouring matter from the fabric.
→ It can be achieved in many ways. They are.
  • By using dil. hypochlorite solution at room temperature.
  • By using Hydrogen peroxide at 80-85°C
  • By using sodium chlorite at boil.
  • By using peroxy compounds like acetic acid.

• An efficient bleaching properties:
→ An efficient & proper bleaching must ensure.
  • Pure & permanent white.
  • Levelling Dyeing properties.
  • There should not be any tendering of material during bleaching.

Sodium Hypochlorite:

→ Sodium hypochlorite is a salt of hypochlorous acid.
→ It doesnot exist in solid form.
→ It can be prepared in an aqueous solution.
→ Sodium Hypochlorite consists of 14-15% of available chlorine.
→ It loses its strength when packed in air tight container.

- **Properties:-**

→ It consists of 14-15% of chlorine.
→ In air tight container, loses its strength.
→ Solution will be stable, if kept away from the sun.
→ It undergoes decomposition rapidly, if this condition not maintained.

- **Manufacturing of sodium hypochlorite:**

→ It is manufactured by
  - dissolving chlorine in a solution of
    - Sodium carbonate (or) sodium hydroxide

$$2NaOH + Cl_2 \rightarrow NaOCl + NaCl + H_2O$$
$$Na_2CO_3 + Cl_2 \rightarrow NaOCl + NaCl + CO_2$$

→ oxidising agents forms oxycellulose by reaction with cellulose. [cellulosic fiber- cotton]
→ cellulose forms the base for the plant fibers.

- **Oxycellulose:-**

oxidising agent + cellulose → oxycellulose

→ oxycellulose are of 2 types → high reducing power
  - → great affinity for basic dye.

* High reducing power:
→ It is under acidic conditions.

→ under acidic conditions → hypochlorite oxidation of cellulose → produces oxycellulose → with high reducing power & high alkali solubility

→ under alkaline conditions
↳ hypochlorite oxidation of cellulose
↳ produces oxycellulose
↳ with great affinity for basic dye.

→ pH of hypochlorite solution determines
- type
- nature

} of oxycellulose formed.

- **Stability of aqueous solution depends on**
  - → Temperature
  - → pH
  - → concentration
  - → presence of impurities
  - → storage conditions [exposed to light or not]

- **Decomposition of NaOCl:**

→ NaOCl decomposes at favourable conditions.
→ It undergoes self decomposition. as follo

$$2NaOCl \rightarrow NaCl + NaClO_2$$

- **Remedies for self decomposition:**

→ Because of self decomposition, suitable storage conditions are
- alkalinity (not acidic) about 2N.
- temperature 0 - 5°C
- concentration about 100 g/l available chlorine.
- Away from sunlight.

Notes to Remember:

→ pH determines acidic nature
→ It ranges from 1 to 14
→ In this, 7 is considered as middle
→ If the value is above, 7 it is alkaline.
→ If it is below 7, it is acidic.
→ Number 1 is considered most acidic.

* Working process of Bleaching:

→ When cotton goods are to be bleached,

- they are scoured & packed into a vessel.
- The vessel may be wood, stone (or) stainless steel.

• **Parts of machine:**

→ It consists of a rectangular (or) cylindrical vessel.

→ This vessel consists of perforated false bottom [Perforated – Holes]

→ It has an outlet [வெளியேறும் பகுதி] to a sump [குழி]

→ This sump [Pit / குழி] has the same capacity of the vessel.

• **Sump:-**

→ Bleaching liquor is prepared in this sump.

→ Liquor is prepared in desire concentration of chlorine ↓ with sodium hypochlorite solution.

→ It is then pumped up.

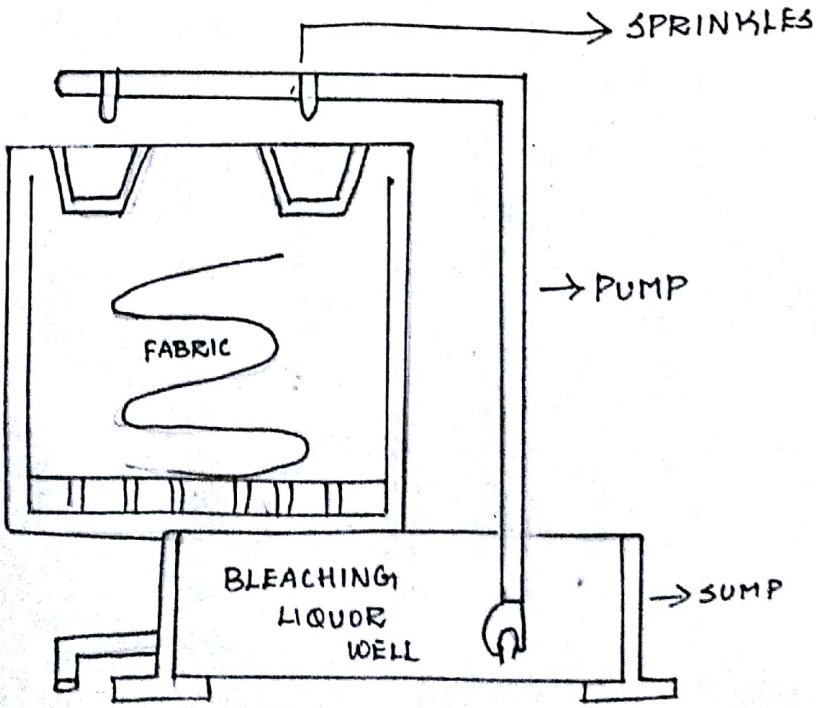
→ It is spreaded through fabrics by sprinkling.

→ It is sprinkled over the top of cotton goods.

→ It percolates [வடிகட்டு / Filter] into the sump again.

→ The process is repeated till required bleaching obtained.

HYPOCHLORITE BLEACHING UNIT



* **Effects of Sodium hypochlorite:**

→ Effects of sodium hypochlorite can be determined by following conditions.

- Time of contact
- Effect of temperature
- Effect of pH.

• Time of contact:

→ Longer the time of contact with cotton material by oxidising agent

- larger amount of oxygen transferred
  - to cotton
  - from solution.

→ With
- proper temperature
- pH
- Concentration
- time of contact

} good bleaching is obtained.

• Effect of temperature:

→ Bleaching is more rapid [speed] at high temperature

→ Hypochlorite solutions are stable at boil temperature

→ pH values are of 11 or higher.

→ The solution decomposes at lower pH value.

• Required elements:

→ Because of this decomposing property,

- Bleaching is accelerated
- at elevated temperature
- Carried out at not less than pH value of 11.

• Effect of pH:

→ The pH value for bleaching
- should be maintained at value of 11.

→ It gives good bleaching at this rate.

BLEACHING WITH SODIUM CHLORITE [$NaClO_2$] ④

SODIUM CHLORITE:

→ Sodium chlorite is an universal bleaching agent.

→ It is used for bleaching all types of synthetic fibres.

→ It is a safe bleaching for cotton.

→ It can be used over wide range of conditions of
- time
- temperature
- acidity
- alkalinity.

→ Sodium chlorite marked under trade name "TEXTONE"

• conditions for bleaching:

→ For cellulosic material:
- TEXTONE used under acidic conditions
- at elevated [higher] temperature

[or]
- with hypochlorites
- at room temperature

→ No chlorine is liberated at these processes.

→ These reactions gives chlorine dioxide.

• chlorine dioxide:

→ chlorine dioxide causes bleaching agent. action

→ Speed of bleaching
- depends on pH.
- It is more fast as pH falls.

• Usage of sodium chlorite:

→ It is generally not used for cotton bleaching.

→ It is costly

→ It evolves chlorite which is dangerous
- for worker's health.
- also affects the surface of the machine. by corrosion.

→ In case of synthetic fiber,
- used as no other effective bleaching agent.

• Functions of Sodium Nitrate:

→ Sodium nitrate is added to the bleaching bath.
→ Bleaching is carried out in stainless steel bath.
→ It prevents the material of machine from corrosion.
→ So, it is best to add Sodium Nitrate with
  • Sodium chlorite
  • to prevent corrosion.

BLEACHING WITH HYDROGEN PEROXIDE [H_2O_2]

→ Hydrogen peroxide bleaching is a costly process.
→ Chemicals used in peroxide bleaching is of higher cost.
→ It is costlier than hypochlorite bleaching.
→ But peroxide bleaching has certain advantages.

Advantages:-

→ In hypochlorite bleaching :-
  • It is essential to remove all the impurities from the fiber.
→ In peroxide bleaching :-
  • Process is carried out in alkaline liquor at boil.
  • Scouring & bleaching can take place simultaneously

Properties of H_2O_2 :-

→ Hydrogen peroxide clear syrupy liquid.
→ It is colourless in small quantity.
→ It appears bluish in bulk quantity.
→ Pure hydrogen peroxide is fairly stable for several weeks.
  • If it is kept away from sunlight.
→ In presence of alkali, Hydrogen peroxide decomposes
  • with liberation of oxygen.

→ They are more stable in presence of → Sulphonic acid
→ phosphonic acid.

→ Addition of → alcohol (or) glycerine } also stabilizes hydrogen peroxide.

Effect of Temperature:

→ As Temperature ↑ increases
- stability of H_2O_2 ↓ decreases

→ For cellulosic (or) Man made fibres
- time for bleaching would be too long
- at temperature lower than 80°C.

→ In normal practice, bleaching is carried out at 90 to 100°C.

→ In pressurised machine, temperature up to 130°C.

→
- oxygen will evolve from water
- collect at the top of enclosed vessel.

→ Presence of this oxygen in contact with cellulosic fibres
- in alkaline state
- at high temperature.
- lead to formation of oxycellulose
- causes tendering.

→ If precautions are taken to permit the
- escape of free oxygen.
- It is possible to bleach in periods
- as short as 20 minutes
- after reaching maximum working temperature
- in pressurised vessels.

Catalysts:-

→ The metals & their oxides catallytically (boosting agent)
- decompose hydrogen peroxide

→ catalytic metallic ions causes
- increased degradation of cellulose.

* Stabilizers:-

→ Sodium silicate forms chick with metallic ions
→ These complexes have powerful catalytic effect.
→ So, Sodium silicate has excellent stabilizing effect
→ Presence of proteins increases the bleaching process in safety manner.

• Advantages:-

→ Sodium silicate is cheaper in cost.
→ It is highly efficient.
→ It can be handled easily.

• Disadvantages:-

→ It is not suitable for continuous process.
→ It forms insoluble compounds on the equipment surface.
→ It also causes abrasion of clothing (or) cloth
  • that comes in contact with sodium silicate.
→ It is difficult to remove the stains obtained
  • during this process.

• Remedial measures:-

→ To overcome this decompose problem
  • Sodium silicate replaced by phosphates.

• Effect of Alkali:-

→ In presence of acid (or) neutral solution,
  • H_2O_2 not an active bleaching agent
  • for cellulosic material.
  • This is because of slow liberation of perhydroxyl ion.
→ If alkali is used excess
  • It causes instability / decomposition } by production of oxygen.
→ Increase in alkalinity, decreases the stability of H_2O_2.

→ When sodium silicate as stabilizer,
- harshness is caused by decomposition
- of insoluble silicon compounds

→ It causes trouble in package dyeing machine.

Effect of cotton impurities:-

→ Water insoluble impurities in raw cotton
- have considerable stabilizing effect.

→ This effect is lost
- If cotton is scoured by prolonged boiling
- with sodium hydroxide.

→ If the material is not with more impurities
- It is advisable to bleach
- unscoured cotton.

→ If scouring is unavoidable
- the treatment should be mild.

•Effect of water:-

→ Sodium silicate to act as stabilizer.
- magnesium salt should be added.
- It is made possible using hard water.

→ Water having hardness between
- 2° to 7° gives good results

→ For cold water process,
- 0.1 to 0.2 g/l of magnesium sulphate is added.

Preparation for Bleaching:

→ Some enzymes cause catalytic decomposition of H_2O_2

→ If those enzymes are used in enzymatic desizing,
- thorough rinsing of goods is important.
- This avoids catalytic decomposition of

• Pretreatment:

→ Goods may be pretreated with hydrochloric acid

→ Hydrochloric acid partially decompose hydrolyse
  • size mixture [starch]

→ It also removes → calcium
  → magnesium
  } present in the fibre.

→ In J-box, due to continuous process
  • 2% of hydrochloric acid used.
  • Because dwelling [ನಿಲ್ಲುವುದು] period is of 30 to 60 min

→ If soaked in pits, for overnight,
  • Concentration of H_2O_2 reduced to 0.2 to 0.3%.

→ During dwelling period,
  • goods should be covered with
    • plastic sheeting.

Sodium Hydroxide Pretreatment:

→ In some cases, pre treatment with sodium hydroxide
  • becomes necessary.

→ This is used when H_2O_2 not carried out at boil

  • This makes → scouring
    → bleaching
    } do not take place simultaneously.

Chemistry of Hydrogen peroxide:

→ Hydrogen peroxide discovered in 1818.

→ It is used for bleaching silk in 1878.

→ One of the main problem was instability of Peroxide solution.

→ In 1925, great improvements were made
  • in production of Hydrogen Peroxide.

→ The method is practicable
  • with temperature range of 80-85°C.

→ Below 80°C, bleaching is low

→ above 85°C, loss of oxygen is too rapid.

Practical method of bleaching:

→ The most important factor in bleaching is
- to achieve right degree of stability
- in bleaching liquor.

→ If pH is too low,
- ions are liberated
- This liberation makes bleaching process donot take place.

→ When liquor is too unstable,
- whole of oxygen is liberated.
- This makes no reaction of bleaching on cotton

- Metals can be used:

→ Metallic ions like → copper, iron } have catalytic action.

→ This catalytic action causes rust on the metals.

→ So the metals → copper, iron } should not be used in bleaching vessels.

→ Stainless steel is more satisfactory.

→ Sometimes → concrete lined vessels, plastic lined vessels } are also used.

Bleaching using kier:

→ Simplest method of bleaching cotton
- with H_2O_2
- is bleaching in kier.

→ If iron vessels such as kiers are used,
- Silicate cement lining is applied.