

SCOURING TREATMENT OF COTTON WITH ALKALINE SOLUTION

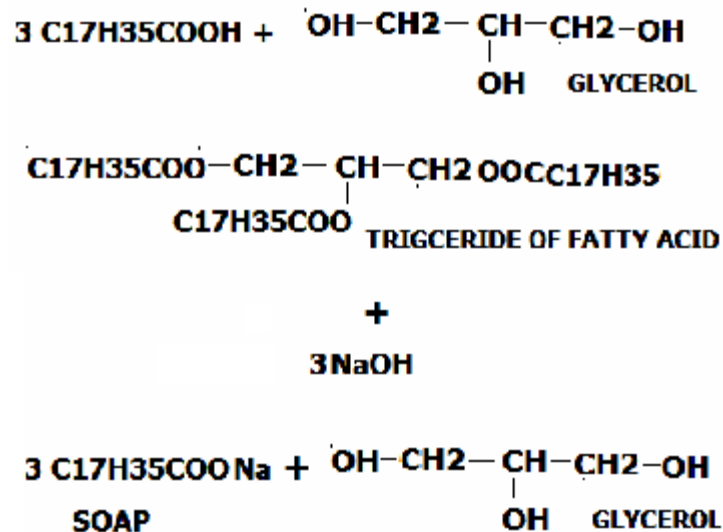
PURPOSE

- **REMOVE NATURAL IMPURITIES : FATS AND WAXES, PECTIC SUBSTANCES, PROTEINS**
- **REMOVE ADDED IMPURITY : OIL STAINS**
- **SEED COAT FRAGMENTS (Kittys)**
- **IMPROVE WATER ABSORBENCY FOR UNIFORM DYEING, PRINTING AND FINISHING.**

MECHANISM

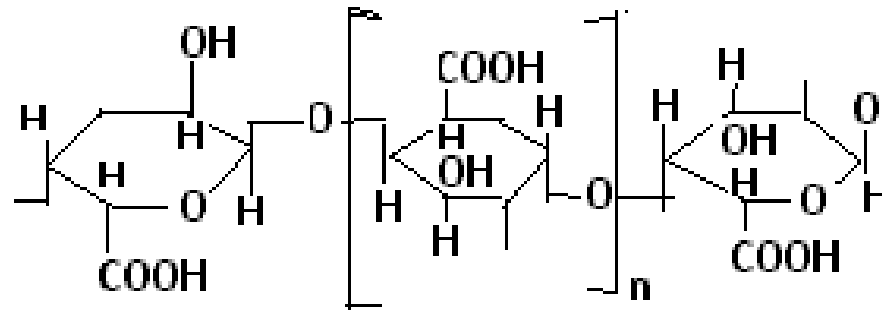
FATS AND WAXES

- SAFONIFICATION OF FATS AND WAXES BY ALKALI AND KEEPING THE DEGRADATION PRODUCTS IN SUSPENDED FORM WITH THE HELP OF EMULSIFYING AGENTS FOR EASY REMOVAL DURING WASHING
- IN EXTREME CASES SOLVENTS IN EMULSIFIED FORM ARE USED FOR SOLUBILIZATION OF FATTY SUBSTANCES



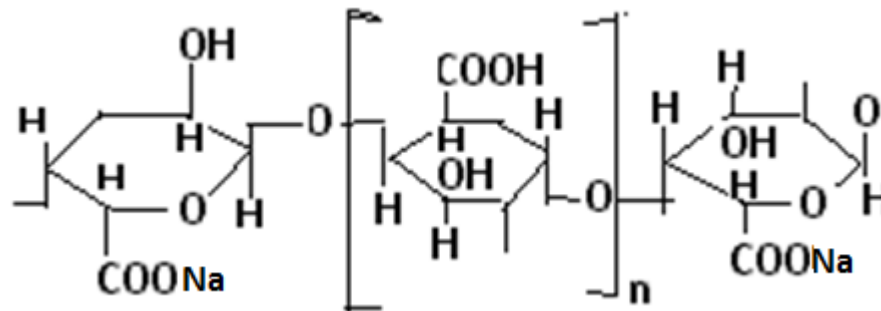
FATS CAN BE EASILY SAPONIFIED BY NaOH INTO SOAP AND GLYCEROL

PECTIC SUBSTANCES



PECTIC ACID
(water insoluble)

CONVERTED TO WATER SOLUBLE Na SALT OF PECTIC ACID



Water soluble

PROTEINS

- **HYDROLYSIS INTO SIMPLE WATER SOLUBLE AMINO ACIDS**

MINERAL MATTER

- **REMOVE DURING SOURING (Neutralization of alkali by acid)**

SUMMARY OF REMOVAL OF IMPURITIES

Impurities	Method of removal
Fats and waxes	Levels are reduced to acceptable limits by the action of alkali and surface active products, in extreme cases the use of solvent and surfactant mixtures may be necessary.
Pectins and related substances	Solubilised by the action of alkali, usually caustic soda, which also acts as a swelling agent to facilitate removal.
Minerals and heavy metals	(a) By producing more soluble salts e.g. acid demineralisation (b) By use of sequestering agents.
Amino acids or proteins	Solubilised by producing corresponding sodium salt.
Lubricants/Knitting oils	Modern mineral oil formulation usually contain their own self-emulsification system.

SCOURING AGENTS

CHOICE DEPENDS ON NATURE OF FIBRE AND NATURE OF IMPURITIES TO BE REMOVED

ALKALIES

- **NaOH, Na₂CO₃, Na₂SiO₃, Na₃PO₄ etc**
- **HELP IN THE SAPONIFICATION OF OILS, FATS AND WAXES**

SURFACTANTS/WETTING AGENTS

- **ANIONIC, NONIONIC, SHOULD BE STABLE TO NaOH AT HIGH TEMPERATURE**
- **IMPROVE FIBRE WETTING FOR BETTER PENETRATION OF CHEMICALS**

EMULSIFYING AGENTS (NON-IONIC)

KEEP THE DEGRADED IMPURITIES IN SUSPENDED FORM TO PREVENT THEIR DEPOSITION ON FIBRE AND EASY REMOVAL DURING SUBSEQUENT WASHING

SOLVENTS

TRICHLORO OR PERCHLORO ETHYLENE

SOMETIMES USED IN EMULSIFIED FORM ALONG WITH ALKALI FOR REMOVAL OF FATTY OILS, FATS AND WAXES WHICH ARE DIFFICULT TO SAPONIFY BY ALKALI

AUXILIARY CHEMICALS

SEQUESTERING AGENTS

- ALSO KNOWN AS METAL CHELATING AGENTS
- BIND HEAVY METALS LIKE Cu, Fe, Ca, Mg PRESENT IN WATER
- MINIMIZES FABRIC DEGRADATION
- MOST COMMON AGENT IS EDTA (ETHYLENE DIAMINE TETRA ACETIC ACID). MANY OTHER TRADE PRODUCTS AVAILABLEE
- SELECT PRODUCT WHICH IS STABLE UNDER TREATMENT CONDITIONS

AUXILIARY CHEMICALS

MILD REDUCING AGENT

- LIKE NaHSO_3 PREVENT THE FORMATION OF OXYCELLULOSE DURING ALKALINE BOIL
- SHOULD NOT BE USED DURING TREATMENT WITH COLOUR WOVEN EFFECTS

AUXILIARY CHEMICALS

MILD OXIDIZING AGENT (SOD. SALT OF m-NITRO BENZENE SULPHONIC ACID TRADE PRODUCT RESIST SALT L

- **USED IN CASE OF COLOURED THREAD EFFECT**
- **PROTECT THE BLEEDING OF DYE FROM FABRIC DUE TO REDUCING ACTION OF CHO GROUPS (ALDEHYDIC) OF CELLULOSE**
- **PREVENT STAINING OF WHITE PORTIONS**
- **MAINTAIN BRIGHTNESS OF COLOUR**

AFTER TREATMENTS

- COLD WASH
- HOT WATER WASH
- NEUTRALIZE WITH 2 – 3g/l HCl OR H₂SO₄
- WASH WITH COLD WATER TO NEUTRAL pH.

TYPICAL RECIPES

BATCH SCOURING PROCEDURE

NaOH	3% owf
Na₂CO₃	1% owf
WETTING AGENT	0.2-0.4%
SEQUESTARANT	0.1-0.2%

B. CONTINUOUS SCOURING PROCEDURE

NaOH	30-40 g/l owf
Na₂CO₃	10 g/l
WETTING AGENT	2 g/l
SEQUESTARANT	1 g/l

- 1. SATURATE FABRIC WITH CHEMICALS**
- 2. STEAM FABRIC ONE HOUR AT 100 degC
IN J-BOX OR STEAMER.**
- 3. RINSE THOROUGHLY WITH COLD AND HOT
WATER AT 60 deg.C**

**THE RECIPES ARE ONLY
GUIDELINE
EACH MANUFACTURING
UNIT STANDARDISE OWN
RECIPE DEPENDING ON THE
EQUIPMENT AVAILABLE AND
PROCESS CONDITIONS**

DETERMINATION OF SCOURING EFFICIENCY OR QUALITY CONTROL TESTS

WATER ABSORBENCY TEST

**1 TIME REQUIRED FOR WATER DROP ABSORPTION
(STANDARD : WITHIN 3 SECONDS**

**2 SINKING TIME 2.5X2.5 Cm SQUARE PIECE
STANDARD : 5-10 SECONDS**

**3 CAPILLARY RISE IN A FIXED TIME
HIGHER THE CAPILLARY RISE BETTER WETTING**

**LOSS IN WEIGHT 3-5% (EXCESSIVE WT. LOSS
INDICATES FIBRE DEGRADATION**

BLEACHING

THE PROCESS OF REMOVAL OF NATURAL COLORING IMPURITIES FROM COTTON IS KNOWN AS BLEACHING

CREAM COLOUR OF COTTON AFTER SCOURING

PRESENCE OF FLAVONE PIGMENTS (MORRIN AND GOSSYPETIN)

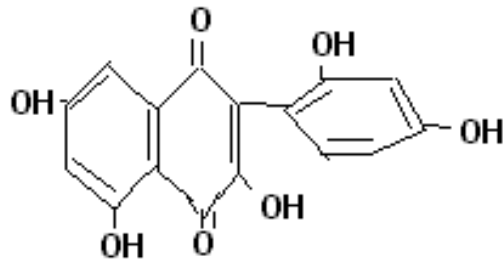
CLIMATE AND SOIL CAUSE VARIOUS DEGREE OF YELLOWNESS

TIPS OF LEAVES COMING IN CONTACT WITH MOIST COTTON BOLL CAUSE YELLOW SPOTS

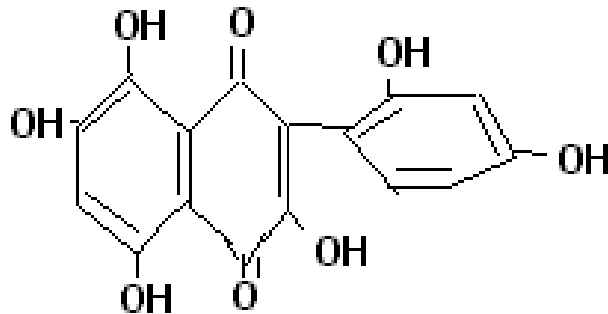
DISCOLORATION DUE TO DIRT/DUST, INSECTS OIL STAINS FROM HARVESTING MACHINERY.

Colouring matter

- Colour pigments present are
- 3,5,7,2', 4' Penta hydroxy flavone (Morrin)



- 3,5,7,8,2',4' Hexa hydroxy flavone (Gossypetine)



**COLORING MATTERS ARE
DECOMPOSED BY
OXIDIZING AGENTS
KNOWN AS
BLEACHING AGENTS**

OBJECT OF BLEACHING

PURPOSE

TO PRODUCE WHITE FABRIC BY DESTROYING COLOURING MATTER WITH MINIMUM FIBRE DEGRADATION.

FURTHER IMPROVEMENT OF WHITENESS BY TREATMENT WITH OPTICAL BRIGHTENING AGENTS WHEN THE FABRIC IS TO BE MARKETED AS WHITE

IMPROVEMENT OF BRIGHTNESS OF COLOR AFTER DYEING

CLASSIFICATION OF BLEACHING AGENT

OXIDIZING BLEACHING AGENT

CHLORINE SYSTEM

PEROXIDE SYSTEM

CHLORINE SYSTEM

- **BLEACHING POWDER ($\text{Ca}(\text{OCl})_2$)**
- **SODIUM HYPOCHLORITE (NaOCl)**

ECONOMICAL, NOT POPULAR PRESENTLY DUE TO ENVIRONMENTAL PROBLEMS

- **SODIUM CHLORITE**

EXPENSIVE. MAINLY USED FOR SYNTHETIC FIBRES

PEROXIDE SYSTEM

HYDROGEN PEROXIDE: MOST POPULAR FOR COTTON

PER ACETIC ACID: EXPENSIVE, LIMITED USE FOR NYLON

SODIUM PERBORATE: SLOW BLEACHING ACTION

**POTASSIUM PERMANGANATE: STRONG BLEACHING
ACTION. FIBRE DEGRADATION.**

BLEACHING

BLEACHING AGENTS

OXIDIZING AGENTS ARE COMMONLY USED FOR BLEACHING OF COTTON

- 1. BLEACHING POWDER (CALCIUM HYPOCHLORITE)**
- 2. SODIUM HYPOCHLORITE**
- 3. SODIUM CHLORITE**
- 4. HYDROGEN PEROXIDE**
- 5. PERACETIC ACID**

**MOST COMMON HYDROGEN PEROXIDE
ENVIRONMENT FRIENDLY. DECOMPOSES INTO WATER
AND OXYGEN
EXPENSIVE COMPARED TO BLEACHING POWDER AND
SODIUM HYPOCHLORITE**

REDUCTIVE BLEACHING AGENT

SULPHUR DIOXIDE

SODIUM HYDROSULPHITE

SODIUM SULPHOXYLATE

FORMALDEHYDE

SODIUM BISULPHITE

NOT SUITABLE FOR COTTON

MAINLY USED FOR BLEACHING OF WOOL

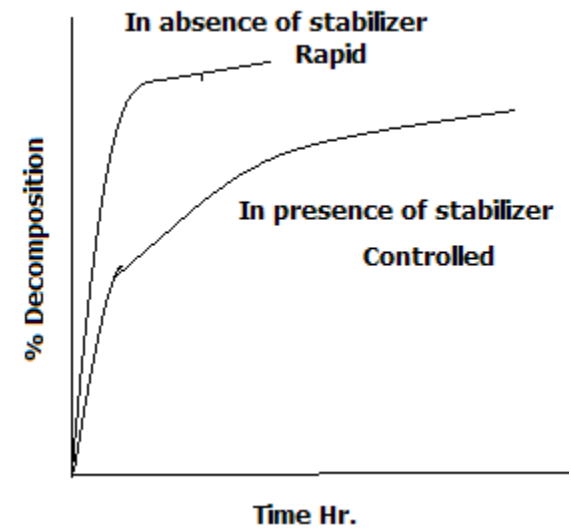
HYDROGEN PEROXIDE

Properties

- **Colourless liquid**
- **Corrosive to skin, dangerous to eyes**
- **Stable under acid pH**
- **Stabilized by phosphoric acid**
- **Activated under alkaline pH**
- **NaOH, Na₂CO₃, Trisodium phosphate alone or in combination may used as alkali for activation**
- **Decomposition in presence of alkali alone is very rapid**
- **Uneven bleaching**
- **The use of stabilizer along with alkali essential during bleaching**

Stabilizer

- Compounds which control the rate of decomposition of H_2O_2 under alkaline conditions.
- Sodium silicate is the most common and economical stabilizer
- Other non silicate based stabilizers include
 - Metal chelating agents like EDTA
 - Decomposition products of protein
 - $MgCO_3$ and $CaCO_3$ present in hard water
 - Polyacrylates etc.



VOLUME STRENGTH OF H₂O₂

THE STRENGTH OF COMMERCIAL HYDROGEN PEROXIDE IS EXPRESSED IN TERMS OF THE VOLUME OF OXYGEN LIBERATED BY A UNIT OF VOLUME OF H₂O₂ SOLUTION.

THUS

A 10-VOLUME PEROXIDE SOLUTION IS MEANS 1 ML OF H₂O₂ IS CAPABLE OF LIBERATING 10 ML OF OXYGEN.

<i>Volume</i>	<i>Weight per cent</i>
3.3	1
10	3
100	27.2
131	35
197	50

HYDROGEN PEROXIDE IS GENERALLY AVAILABLE 10, 20, 100 AND 130 VOLUME STRENGTH.

THE STRENGTH OF H₂O₂ IS ALSO EXPRESSED IN %
IT IS AVAILABLE COMMERCIALY AS 35 AND 50% SOLUTIONS.

THE STRENGTH OF THE H₂O₂ CAN BE ESTIMATED BY TITRATING THE PEROXIDE USING STANDARDISED POTASSIUM PERMANGANATE (KMNO₄) UNTIL FAINT PERMANENT PINK COLOUR APPEARS.

MECHANISM OF H₂O₂ BLEACHING

- INITIAL UNDERSTANDING
- $2 \text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2$
- NOT CORRECT BECAUSE BLEACHING NOT ACHIEVED BY ATMOSPHERIC OXYGEN
- PRESENT UNDERSTANDING:
- IN AN ALKALINE SOLUTION THE PERHYDROXYL AND HYDROXYL RADICALS ARE PRODUCED WHICH ARE ACTIVE BLEACHING AGENT (REACTION 1 AND 2).
- IN A SECONDARY REACTION (3) MOLECULAR OXYGEN IS FORMED THAT HAS NO BLEACHING ACTION.



IN ORDER TO PREVENT RAPID RATE OF FORMATION OF HO₂- RADICALS IT IS NECESSARY TO ADD STABILIZER AND CONTROL pH

Mechanism of bleaching action

HYDROGEN PEROXIDE IS STABLE IN ACIDIC MEDIUM, THEREFORE, BLEACHING OCCURS BY THE ADDITION OF ALKALI AT INCREASED TEMPERATURE (80-100° C)

HYDROGEN PEROXIDE LIBERATES PERHYDROXYL ION (HO₂·) IN AQUEOUS ALKALINE MEDIUM.

THE PERHYDROXYL IONS ARE RESPONSIBLE FOR DECOMPOSITION OF NATURAL COLOUR IMPURITIES IN COTTON.

THE RATE OF DECOMPOSITION IS OPTIMUM AT pH 10.5-10.8. A MIXTURE OF NaOH AND Na₂CO₃ ALONG WITH STABILIZER USED TO GET THE OPTIMUM pH.

AT HIGH pH (HIGH ALKALINITY) THE RATE OF DECOMPOSITION IS RAPID.

AT HIGHER PH (ABOVE 10.8) THE LIBERATION OF HO 2· ION IS SO RAPID THAT IT BECOMES UNSTABLE WITH THE FORMATION OF OXYGEN WHICH HAS NO BLEACHING PROPERTY.

IF THE RATE OF DECOMPOSITION IS VERY HIGH, THE UNUTILISED HO 2· MAY DAMAGE THE FIBRE.

A SAFE AND OPTIMUM PH FOR COTTON BLEACHING LIES BETWEEN 10.5 TO 10.8

STABILISERS FOR PEROXIDE BLEACHING

STABILIZERS MUST BE ADDED TO THE BLEACH SOLUTION TO CONTROL THE DECOMPOSITION OF HYDROGEN PEROXIDE.

STABILIZERS FUNCTION BY PROVIDING BUFFERING ACTION TO CONTROL THE PH AT THE OPTIMUM LEVEL AND COMPLEX WITH TRACE METALS WHICH CATALYZE THE DEGRADATION OF THE H₂O₂ AND FIBER.

STABILIZERS INCLUDE SODIUM SILICATE, ORGANIC COMPOUNDS AND PHOSPHATES.

SODIUM SILICATES

SODIUM SILICATES ARE THE MOST COMMONLY USED AND MOST EFFECTIVE HYDROGEN PEROXIDE BLEACH STABILIZERS.

THE MECHANISM BY WHICH SILICATE STABILIZE H₂O₂ IS NOT COMPLETELY UNDERSTOOD,

HOWEVER IT IS KNOWN THAT SILICATES HAVE A AFFINITY FOR FERROUS IONS AND FERROUS IONS ARE NATURALLY PRESENT IN COTTON AS WELL AS IN WATER USED FOR PROCESSING

IT IS POSSIBLE THAT THE SILICATES FORM THE COMPLEX WITH FERROUS IONS AND REDUCE ITS CATALYTIC EFFECT ON THE DECOMPOSITION OF H₂O₂.

IN THIS WAY CONTROLLED RATE OF DECOMPOSITION OF H₂O₂ IS OBTAINED.

SILICATES ALSO ACT AS BUFFER AND THUS HELP IN MAINTAINING CONSTANT pH

PROBLEM ASSOCIATED WITH SODIUM SILICATE

IF NOT COMPLETELY REMOVED AFTER BLEACHING PRODUCE

SILICATE STAINS ON COTTON

NON-UNIFORM WHITENESS

UNEVEN DYEING

ORGANIC STABILIZERS

ORGANIC STABILIZERS AVOID THE PROBLEMS ASSOCIATED WITH SODIUM SILICATES.

THESE PRODUCTS ARE OFTEN REFERRED TO AS SILICATE FREE OR NON-SILICATE STABILIZERS.

THEY MAY BE BASED ON SEQUESTERING AGENTS, PROTEIN DEGRADATION PRODUCTS OR ACRYLATE POLYMERS, SOME SURFACTANTS ALSO ACT AS STABILIZERS.

ORGANIC STABILIZERS MAY BE USED ALONE, OR IN COMBINATION WITH SILICATES.

TYPICAL BLEAHING PROCEDURES

BATCH PROCESS

Hydrogen peroxide (35 %) 3-5% owf

Wetting agent 0.1-0.5%

NaOH 0.3-0.8

Sodium silicate 2-3%

Magnesium sulfate
(Epsom's salt) 0.5%

TREAT FOR 60-90 MIN

TEMP. 95-100 deg C

DROP BATH

RINSE WITH HOT AND
COLD WATER

CONTINUOUS PROCESSING

A typical recipe for a wet on wet bleaching in a roller bed continuous system

J-BOX OR ROLLER STEAMER

Hydrogen Peroxide 35% (135 volume) 50-60 ml/l

Sodium Silicate 10 g/l

Organic Stabilizer 10 g/l

Sodium Hydroxide 3 g/l

Wetting Agent 1-2 g/l

Liquor Pick-up 100%

Sequence: Pad-steam for 1-2 hours at about 95°C. (J-Box)

IN CASE ROLLER STEAMER STEAMING IS CARRIED OUT FOR 3-5 MIN. AT 102 DEG.c

Concentration of the reactants and the time of treatment may vary according to the degree of impurities and quality of whiteness required.

In the sem-icontinuous pad-roll process time of steaming is usually 4 to 5 hours.

COLD PAD-BATCH PROCESS

This process consists of padding fabric with 40- 50 ml/l hydrogen peroxide (35%), 15-20 ml/l sodium silicate , 10-15 g/l caustic soda and 3-5 g/l of a wetting agent pick-up of 100%.

The batch roll is covered with a plastic sheet and slowly rotated (4 rpm) at room temperature for 15 to 24 hours washed in an open width washing range with boiling water.

ADVANTAGES

inexpensive equipment

Free of danger of catalytic damage to the fibres.

However, degree of whiteness is inferior to that obtained by the steaming process.

OPTICAL BRIGHTENING OR FLUORESCENT WHITENING OF BLEACHED FABRIC

OPTICAL BRIGHTENERS OR FLUORESCENT WHITENERS

EVEN AFTER BLEACHING THE BLEACHED FABRIC HAS YELLOWISH TINGE

BLEACHED FABRIC IS SUITABLE FOR DYEING BUT IF THE FABRIC IS TO BE SOLD AS WHITE, THERE IS NEED TO FURTHER IMPROVE THE WHITENESS AFTER BLEACHING

FURTHER IMPROVEMENT IN WHITENESS AFTER BLEACHING IS OBTAINED BY PHYSICAL PROCESSES

1. TREATMENT WITH BLUEING AGENT

2. TREATMENT WITH OPTICAL BRIGHTENING AGENTS (OBA)

TREATMENT WITH BLUEING AGENTS

**BLUEING AGENTS ARE BLUE PIGMENTS
DO NOT HAVE AFFINITY TO FIBRE
MECHANICAL DEPOSITED ON FABRIC
SINCE THESE AGENTS REFLECT LIGHT IN THE BLUE REGION
OF THE VISIBLE SPECTRUM THEY COMPENSATE
(COUNTERACT) FOR THE YELLOW TINGE OF BLEACHED
FABRIC
THUS THE FABRIC APPEAR MORE WHITE WITH BLUE TINGE**

OPTICAL BRIGHTENING AGENTS

OPTICAL BRIGHTENING AGENTS ARE CONSIDERED TO BE COLOURLESS DYES HAVING AFFINITY TO FIBRE TO WHICH THEY ARE APPLIED

PROPERTY

ABSORPTION OF LIGHT IN THE UV REGION AND REFLECTION IN THE VISIBLE REGION

PHENOMENON OF WHITENESS

WHITNESS DEPENDS ON THE %REFLECTION OF LIGHT FROM THE FABRIC SURFACE

HIGHER THE %REFLECTION BETTER WILL BE THE WHITNESS

WHY OBA IMPROVE THE WHITENESS

IMPROVEMENT OF WHITNESS ON APPLICATION OF OBA IS A PHYSICAL PHENOMENON

OBA ABSORB THE LIGHT IN THE UV REGION AND REFLECT IT IN THE VISIBLE (BLUE) REGION

THUS ON APPLICATION OF OBA REFLECTION OF LIGHT IN VISIBLE REGION IS FROM TWO SOURCES

- 1. FABRIC SURFACE**
- 2. REFLECTION OF LIGHT DUE TO OBA**

THUS TOTAL %REFLECTION OF LIGHT FROM THE FABRIC SURFACE IS INCREASE

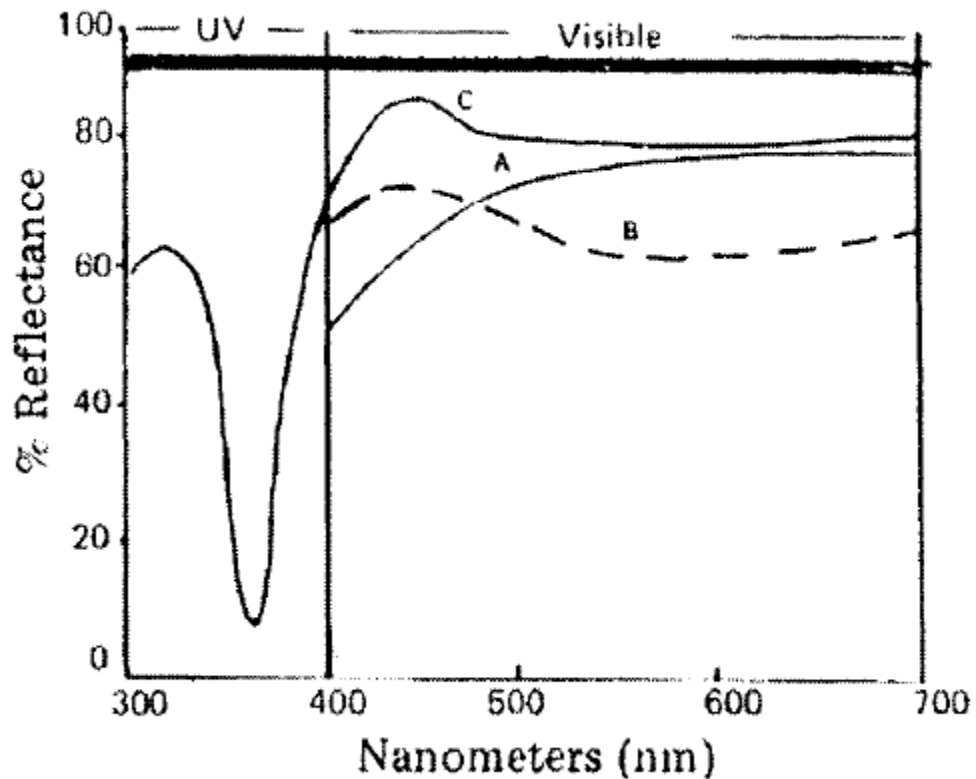
RESULTING IN MORE WHITENESS OF FABRIC

OBA TREATMENT NOT GIVE FOR THE FABRIC WHICH TO BE DYED

REASONS

CHANGE IN SHADE

MANY OBA AFFECT THE LIGHT FASTNESS OF DYES.



Reflectance of a bleached cotton fabric (A), after adding a blue tint (B) and after adding a fluorescent brightener (C)

APPLICATION OF OBA

OBA ARE APPLIED IN THE CONCENTRATION RANGE OF 0.1-0.2% OWF OR 1-2 g/l

AT HIGHER CONCENTRATION THE FABRIC ACQUIRES YELLOWING TINGE

APPLICATION

- 1. DURING BLEACHING: PROVIDED OBA IS STABLE TO BLEACHING AGENT AND BLEACHING CONDITIONS**
- 2. AFTER BLEACHING**

EXHUST METHOD ON JIGGER

PAD-DRY APPLICATION

AFTER APPLICATION OF OBA FABRIC IS NOT WASHED