PROCESS CONTROL AND SAFETY IN CHEMICAL PROCESSING OF TEXTILES

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CHAPTER 1

GENERAL:

The concept of process control measures are becoming popular now days due to two main reasons i)Growing competitions and increasing cost of production. (ii) Textile industry now a day is facing a very stiff competition. This competition is at macro and micro level. Micro may be within a country and macro means competition from industry world over.

Under these circumstances, price and quality becomes important criteria, therefore, process control becomes more essential, for achieving overall success.

Roll of process control in wet processing is to achieve overall profit and higher efficiency. Certain tools are needed to control various phases of production.

THE MAIN FUNCTIONS OF PROCESS CONTROL ARE AS FOLLOWS:

1) Obtaining and maintaining optimum process condition.
2) To minimize the wastage during process and form reproducible results.
3) Establishing correct operating procedure.
4) Carrying out adequate machinery maintenance.
5) Controlling production yield and waste.
6) Setting up of testing sequence.
7) Providing thorough documenting system
8) Accessing the department's effectiveness.

The most important function of process control lab is to reduce the cost, by ensuring the production with required quality, with the help of standard specification.

APPROACH TO PROCESS CONTROL:

The choice of process condition, for the given product is taken by the previous history and forming new norms without affecting quality. The optimum norms may vary from unit to unit and machine to machine. This is because of various reasons like working condition, type of machine, layout of machine, provision of utilities and variations in the quality of the fabric. Therefore every process house has to carry out their own experiments to identify their own optimum processing levels. Once the processing conditions are standardized, then implementation of these conditions during the normal course of production is carried out by keeping required documents. However it is important to select regular inspection checks to ensure that the particular process is going on according to the norms fixed.

QUALITY'S DEFINITION:

Conforming to specification is quality. Quality can also mean, meeting or exceeding, customer's expectation all the time. The customer's expectation can be of different types. The expectations of quality and the ability to distinguish various quality characteristics also vary from group to group of

customers. E.g. more educated customer's requirements are very specific and less educated customer's requirements for quality are less.

Therefore, the quality is classified in four different classes, which are as follows.

1) **Product based quality:**

   Product based definition of quality mainly depends on the quality. Product based quality is more related to manufacture. More the number of units in specified time more is product based quality. From the user point of view more number of units in a specific cost is called product based quality.

2) **User based quality:**

   The user based quality simply means the quality, whatever the customer says or wants. In short, meeting or exceeding customer's requirement and expectations.

3) **Manufacturing based quality:**

   The definition of this quality means, meeting specifications or conformance to requirements. It is nothing but manufacturing based quality. Any deviation from meeting the requirements means poor quality.

4) **Value based quality:**

   In this type of quality, there is more consideration of cost of a product or service.

CHARACTERISTICS OF QUALITY OR DIMENSIONS OF QUALITY:

1) **Performance:**

   It is based on primary operating characteristics of a product. E.g. Performance of machine means, how effectively that machine works.

2) **Features:**

   Features of a product are the secondary characteristics of a product. The secondary characteristics are supplementing the products basic function.

3) **Reliability:**

   Reliability refers to the profitability of a product and keeping away from malfunctioning, the product should conform to the efficiency till a specific period of time.

4) **Conformance**:

   Conformance refers to the extent to which a products design and operating characteristics meets pre established standards.

5) **Durability**:

Durability means the length of time of that product or products life.

6) **Serviceability**:

Serviceability refers to the speed, courtesy, competence and ease of repair of a product.

7) **Aesthetics**:

Aesthetic refers to how that product looks, feels, sounds, taste and smells.

8) **Perused quality**:

It refers to what customer perceives to be the quality of the product, based on the image of advertising and brand name reputation.

The influence of varying one or more of these eight characteristics of quality, a company can position itself in the market. Therefore quality is a strategic variable.

SOME FACTORS INFLUENCING THE QUALITY:

The factors influencing the customer's perception of quality are as follows.

1) Price:

Consumers tend to associate quality with higher price.

2) Technology:

This factor is responsible for improving the necessity of the product, for e.g. a colour fast fabric or shrink proof fabric, because these properties are generated in fabric by introducing specific technology.

3) **Psychology**:

A garment can be reasonably priced at the best technology, can offer. But if it is not attractive or not fashionable, then it may be considered by a consumer that it is of poor quality.

4) Time Orientation:

In short it is durability. If less durability of product to conformance then less is the quality and vice a versa.

5) **Contractual:**

This refers to the products warranty, guaranty etc.

6) **Ethical:**

This refers to honesty of advertising, courtesy of sales etc.

NECESSARY STEPS TO CONTROL QUALITY AND TO MAINTAIN IT:

1) **Create constant process of improvement of product or service:**

Management should never lose sight of the fact that the main purpose of business is to provide goods and services and therefore, business should include constantly improving the products and services.

2) **Adopt New Philosophy:**

Management must take responsibility for poor quality and should be of thinking that most of the problems are created by system and only management can solve those.

3) **Mass Inspection:**

Quality control typically involves inspection of product. This inspection must be carried out at various stages of manufacturing. Many time inspections are saving the cost of production.

4) **Avoiding Business Price tag:**
Purchasing lowest cost material some time gives poor quality product. Purchasing should seek the best quality suppliers and long term relationship. In long run this would be cheaper, than having low quality suppliers.

5) **Constantly improving system of production and services:**

Improvement is not one effort. A management should see constantly towards improvement in system of production. It would reduce the waste and improve the quality with reduction in cost.

6) **Training on the job:**

The worker must be properly trained on the same machine which they will work on. The training must be continuous, as technology and methods change constantly.

7) **Adopting leadership activity:**

The job of the supervisor is not to tell people, what to do and punish them when something goes wrong. But the supervisor should work together and take responsibility. The job of supervisor is to lead i.e. helping people do a better job by coaching, teaching and constantly developing them.

8) **Eliminate fear factor:**

Often employees are afraid to ask questions or to take position, even when they do not understand what their job is or what is right or wrong. They will continue to do things in a wrong way or not do at all. All these results in losses. In order to assure quality and productivity, it is very important that workers feel secure about their job even if they ask some basic question.

9) **Eliminate barrier between departments:**

Many a times certain department does not get idea of end product. It is very important to give, complete information of the product they are working on, to where it will used in.

10) **Eliminate Numerical goal (production target):**

In order to hold a job, people meet production target at any cost, without regards to long term damage to the company. Remove barriers to pride of workmanship. People generally want to do a good work and are frustrated when they cannot. Too often poor supervision, faulty equipment and defective material prevent people from turning out good work.

11) **Rigorous program of education and retraining:**

Without continue education and retraining of everyone in the company, company cannot be competitive.

12) **Put everybody in the company to work:**

Distribution and authority of responsibility should be given to all.

To accomplish the transformation of the company, all above necessary actions must be implemented to maintain quality.

DISEASES TO BE AVOIDED TO MAINTAIN QUALITY:

1) Lack of planning (long term and short term).
2) Emphasis on short term profits.
3) Evaluation of performance by production and not by quality.
4) Management should not make workers change the department now and then.
5) Running company on visible figures and not with satisfaction of customers.
6) Excessive medical cost (lack of health care of workers).
7) Not fulfilling the warranty.

ISO 9000:

ISO 9000 is road map for the series. Its purpose is to provide the users with guidelines for selection and use of ISO 9001, ISO 9002, ISO 9003, ISO 9004. ISO 9001 is the most comprehensive as it is covering design, manufacturing, installation and servicing systems. It covers 20 elements of the company operations. ISO 9002 counts production and installments. 9003 covers only final products inspection and test. The elements which are covered under ISO 9000 standards are as follows:

1) **Management Responsibility:**

   A company should clearly spell out in writing the management responsibilities, in establishing reviewing and providing resources to support the company's quality system and indicate by position as to who is the highest ranking individual in quality related matters and reporting to immediate higher position. This is necessary to make sure that executive management takes a leading and visible role in defining, implementing and administrating the quality system so that the customer requirements are met or exceeded.

2) **Quality systems:**

   This is the vehicle through which a company can produce products and or series that need customer requirements, and continue to do so consistently in the future.

3) **Contact View:**

   This is reviewing customer order or contract to make sure that the customer needs are understood. All requirements are adequately defined and any differences are resolved. Such review is necessary to make certain that company is capable of meeting customer needs before accepting an order or finalizing a contract.

4) **Design Control:**

   This is the process of verifying and validating product design to make sure that the product produced will meet specified design requirements set by customers, and regularly inspecting the same thing.

5) **Documents and data Control:**

   This is necessary to make sure that quality related documents and data are readily available to all users when they need them. This also includes reviewing and revising them periodically and making sure only revised copies of the documents are properly utilized or properly used. Only certain individuals are authorized to make any changes in the documents.

6) **Purchasing:**

   ISO 9001 and 9002 call for adequate control of purchased products through sub contracted evaluation and verification of purchased materials so that these materials are incorporated in company's product or production processes.

7) Control of customer supplied product:

In the event that customer supplied products e.g. parts or sub assemblies, are to be incorporated into final product, adequate control should be exercised to make sure that proper parts are used.

8) Product identification and traceability:

This means a provision for identifying materials at various stages from raw material to finished products so that errors can be traced back for corrective or preventive actions if necessary.

9) Process Control:

This is a way of controlling various processes so that the ultimate outcome is with minimum waste and highest efficiency.

10) Inspection and testing:

This is necessary to make sure that the product confirms to all requirement at each manufacturing stage, to identify non conforming product as early as possible in the process and facility corrective and preventive actions.

11) Control of Non-conforming product:

In order that no one should use unintentionally any defective or non-conforming product, the product must be placed for identification. The control of defective products must be defined by authorized person.

12) Corrective and Preventive Actions:

This means addressing causes of defective product at any stage of process. This also includes procedure in place to prevent occurrence of defective products in the first place. Corrective and preventive actions are necessary to produce a continuously improved product. While handling, storage, packing, preservation and delivery it is very important that the product should not get damaged. Otherwise good quality product converts into defective product. Therefore defective procedures must be implemented, to protect damage to the product.

13) Quality control records (quality audits):

It is necessary to ensure that quality records are easily accessible to customer, if required. The quality records are essential to demonstrate effective operations of quality system.

14) Internal quality records:

To make certain that the quality activities need the requirements to demonstrate effectiveness of the quality system it is necessary to perform periodic internal audits.

15) Training:

Training of the employees is very important in order to produce good quality products and meet customer requirements from them.

16) Servicing:

To ensure complete customer satisfaction it is necessary to provide after sales service wherever appropriate.

17) Statistical techniques:

In order to ensure quality or to detect problems it is necessary to employ statistical techniques in the production processes wherever required.

CHAPTER 2

PROCESS CONTROL IN TEXTILE PRETREATMENTS:

Aim of process control in textile pretreatments is to maintain consistent uniform quality of the material in processes at various stages of manufacturing.

DESIZING:

Nature of Size: **Action:**	Prior to desizing spoofing test. Select correct method of desizing
%Wet pickup during Desizing: **Action:**	Pick up should not be less than 110%. If pickup variation is there then adjust pressure.
Concentration of desizing agent and other ingredients:	HCl-5gpl, Cellulase enzyme 3-5gpl.
Impregnation and dwell time:	Non ionic wetting agent 3-5gpl. Dwell time checked during padding. Ensure optimum dwell time.
Temperature: **Action:**	During desizing in the bath (exothermic reaction may rise the temperature. Acid desizing is done at room temperature. Enzyme desizing is done depending on the enzyme. Regulate the steam supply. In acid desizing replenish the acid solution or provide water cooling system.
pH:	Depending on the Enzyme

Desizing efficiency: Standard- Not less than 85%.

SCOURING:

1) **Kier Lining: Prior to filling the fabric in kier.**

i) STANDARD: No cheeping of interior wall of kier.

ii) ACTION: Ensure proper cementing of interior wall of kier.

iii) FILLING DENSITY: 7-8Kg/Cubic feet during filling of kier.

2) **Removal of Air:**

i) ACTION: Air removal before raising pressure

ii) STANDARD: No air, ensure complete removal of air.

3) **Circulation:**

i) During scouring, circulation is tested by flow rate method.

ii) STANDARD: Smooth circulation.

iii) ACTION: Cleaning of circulation pump.

4) **Recipe:**

i) Concentration of scouring liquor: Check by titration before and during process.

ii) ACTION: Adjust the concentration.

iii) PRESSURE: 15psi or as per quality and regulate steam supply.

iv) TIME: Previous time record or as per quality.

v) CONCENTRATION OF BLEND LIQUOR: Standard 90% must be consumed.

BLEACHING:

By Kinetic study of bleaching, take 3 titration at 5 minutes. If decomposition in 2^{nd} and 3^{rd} titration is fast then metallic impurity is present.-
Remedy: Hexametaphosphate (7-8gpl to 15-20gpl is taken. It does not chelate Fe ion. If Fe ion is present then EDTA is used. If hardness of water is around 250-300 PPM, then 3gpl EDTA is sufficient, but in presence of Fe Ion 6-8gpl is needed at 250-300 PPM Hardness. EDTA chelate is stable at higher temperature).

Concentration of Chemical:

Concentration is selected from uniformity and reproducible results of previous processing. Adjust the feeding concentration of chemical as required.

Stock Solution Quantity:

Take study of MLR of process or nature of fabric quality.
STANDARD: Full consumption of Stock solution should be there, nothing should remain back as wastage.

Temperature:

Check temperature during process. Temperature depends on bleaching process and bleaching chemical. Regulate steam supply as needed.

Time:

METHOD: Dwell time record, concentration of bleaching method and process selected. Give adequate treatment time.

pH:

Adjust the pH during the process by pH indicator or pH paper.

STANDARD: For Hypochlorite 9.5-10.5 and for Hydrogen peroxide 10.5-11.5.

Concentration of Drain:

After bleaching, with the help of titration ensure optimum utilization.

SOURING:

Souring is carried out because alkali traces give rise to yellowness in fabric.

Concentration of acids for Souring:

Acetic acid or Formic acid is generally used. The concentration on an average is 10-15gpl, depending on the alkali remaining on fabric, adjust the concentration of acid.

Flow rate during feeding of acid:

Regulate the flow of acid during feeding.

Time:

As per requirement. Ensure optimum dwell time.

Localized drying during Souring:
STANDARD: There should not be any localized drying.

METHOD: Cover with polythene sheet or cover with wet fabric.

pH During washing:

After the treatment check pH with pH indicator.

STANDARD: No acidity.

CORRECTIVE MEASURES: Regulate the acid flow rate.

Pick up:

METHOD OF STUDY: Pick up study OR 115-120% is average pick up.

NECESSARY ACTION: Regulate Nip Pressure.

MERCERIZATION:

Moisture Control:

More moisture pickup by the fabric means more NaOH and hence more effect. Drying cylinders are kept before mercerization tank to have same moisture content in the fabric throughout for uniform results. Other technique is wet on wet mercerization, where fabric is pre wet but it requires high precaution.

STANDARD: Free from moisture.

METHOD: By sufficient steam in drying cylinder.

Caustic soda solution while padding:

STANDARD: 25% or 50-52^{0}Tw.

METHOD OF CHECKING: Twadle meter or titration.

NECESSARY ACTION: Adjust the concentration according to the requirement. Concentration of NaOH will never change in tank from start to end but then also at a later stage the concentration on Twadle meter increases because the density of solution may increase due to the impurities from the fabric like thickening agent etc.

Temperature of Padding Solution:

Ideally it is carried at room temperature. If the temperature is more, then it is because the moisture in the fabric is more. Water and NaOH leads to exothermic reaction which will increase the temperature. So dry the fabric properly. If still temperature increases then check water cooling line.

Dwell time:

45-60 Seconds.

Wet pick up of NaOH:

Wet pick up is generally 120-125% but it should be perfectly uniform throughout the width and length. Pick up is studied by taking original weight of fabric and weight of fabric after padding. Pick up is checked randomly.

Washing:

First compartment after mercerization tank is recuperator. Here the caustic soda should not be more than 10^0Tw. If its % is very low then take less water. (because if more water is present then NaOH associates itself with more water molecule and its size becomes bigger which is very difficult to remove from the core of the fibre while washing and chances are that we do not get proper washing).

ACTION: Adjust the flow of water.

Temperature of Recuperator:

Here the hot washing is carried out. Live steam is blown in water. So the temperature should not be less than 90^0C.

Caustic soda left on the fabric:

Removal of 100% caustic is very difficult and uneconomical. It should not be more than 1% on fabric and if the quantity is more than 1% then check the washing efficiency, efficiency of recuperator and adjust the flow of water.

Souring:

This treatment is carried out when bleaching is performed on the fabric. In grey mercerization it is not performed. Removal of NaOH is very difficult and hence acid neutralization is very cheap and easy. Removal of alkali by water consumes very high amount of water.

STANDARD: Extract of fabric must be neutral after the souring treatment.

Fabric after washing:

Check the extract of fabric by pH indicator or pH paper

STANDARD: pH must be neutral. If fabric is acidic then adjust flow of water, if alkaline in nature than adjust souring percentage.

CHAPTER 3

PROCESS CONTROL IN DYEING:

YARN DYEING:

Winding density should be even. Package density is checked before loading the package.

First take circumference, then measure height and deduct the center portion of cone that is hollow. Then weigh it so you will get the density. For cotton the package density is taken as 0.3 gram/cc.

Shape of the Cheese:

Shape and size of the cheese should be same. Prior to process checking is done visually.

Checking the angle of the winding:

Angel should be 30-45^0. As the angle increases the density decreases.

Perforation of the spindles:

Perforation of the spindles prior to mounting the spindle. It is visually assessed.

STANDARD: No perforation mark.

NECESSARY ACTION: Wound butter paper or non woven textile. Polycarbide, and polyethylene spindles are only wound. Spring type are not wound..

MLR:

MLR for conventional machine is 1:10. Fongs has reduced the MLR to 1:4.

STANDARD: MLR varies from 1:6 to 1:12 and necessary action is adjusting the MLR as per the requirement.

Pump pressure:
Modern machine gives upto 6-7 Psi and old machines used to give 4psi.

Take necessary action for smooth reversal flow of the liquor.

Recipe Colour and chemical:

Prior to dyeing ensure confirmatory of standard recipe.

Colour Dissolution:

Prior to dyeing check colour dissolution. Method of checking is spotting on filter paper.

STANDARD: Complete dissolution of colour, if partly colour is getting dissolved then strain the solution prior to dyeing.

pH:

Check with pH paper or pH meter.

STANDARD: No standard it varies as per the dye class.

NECESSARY ACTION: By addition of acid or alkali.

Temperature:

Check with thermometer and adjust steam supply.

STANDARD: No standard, it varies as per the class of dye.

Time:

During process, the method of checking is dyeing record.

Entrap air:

Entrapped air is checked prior to built up of the pressure. Method is by checking air vent valve.

STANDARD: No entrap air and ensure complete air removal.

Steam leakages:

During process visual checking is done for no leakage in the pump and circulating valve.

Necessary action: Trap or plug all leakages.

Variation in Package density during process:

In case of cotton carry out pretreatment process with low alkali. In case of polyester texturised yarn due to boiling treatment yarn shrinks, to avoid that either hold the batch at low temperature for longer time i.e 45-60min or adjusting density during winding i.e Wind at lower density so the density increases or become optimum after shrinking.

BEAM AND JET DYEING MACHINES (HTHP DYEING MACHINES)

Parameters for fabric preparation:

Uniform Whiteness, Degree of heat setting is checked by below method

METHOD OF TESTING: Iodine absorbency test. Oil free fabric is necessary.

NECESSARY ACTION: Uneven white fabric is taken for heat setting. Reheatset at higher temperature then previous.

Density of Fabric:

Particularly for Beam dyeing machine optimum density is 0.6gm/cc. (Density calculation as per package dyeing as shown above)

NECESSARY ACTION: To conform to uniform winding of fabric on a beam.
Minimum 8 to 10 layer of wrapper cloth is the standard. If Polyester is more, than more layers of wrapper cloth must be wound. Ensure proper length of wrapper cloth according to the width of the fabric to avoid perforation marks.

Overlap on beam:

During batching this precaution is to be taken that the Blend content or width of the selvedge should be same.

NECESSARY ACTION: Maintaining desired overlap.

Air Entrap:
Before taking the pressure in the beam, entrapped air is removed. Method of checking is overflow valve.
STANDARD: No entrapped air.
NECESSARY ACTION: Circulating the liquor for 5-10 minutes in both the direction.

Flow Reversal:
STANDARD: During the flow reversal the pressure should not be less than (forward pressure of 4 Psi) If pressure is less then it then check the pump. Optimize the number of wrapper layers. Check amount of water in the beam machine, and ensure complete air removal.

MLR:
Beam dyeing MLR is 1:10 to 1:12.
NECESSARY ACTION: Take optimum liquor ratio.

Vessel Pressure:
During dyeing, pressure gauge reading on beam dyeing should be35-40psi.

JET DYEING MACHINE:

MLR's of Various Jet based Machines:

Old Jet	1:8
Rapid Jet	1:6
Super Rapid Jet	1:4-1:5
Soft flow	1:1-1:1.5
Over flow	1:4-1:5
Air Flow	1:1

Jet Pressure:
Jet pressure: 15-20 psi. Adjust jet pressure according to the quality.
In case of soft flow dyeing machine pressure is very low from 3psi to 10psi. Because in this machine

fabric is moved mechanically and jets are used only to penetrate the dye liquor in fibres.
NECESSARY ACTION: Adjusting the jet pressure according to the quality.

Recipe:
No standard for recipe it is as per the quality of fabric.

pH:
During dyeing it is checked by pH meter or pH paper, 4.5-5.5 is the standard.
NECESSARY ACTION: Adjust the concentration of acid buffer.

Temperature:
STANDARD: The standard is set during dyeing as per the requirement with the help of thermometer.
NECESSARY ACTION: Ensure uniform heating rate as per the dyeing program. Maintain uniform steam pressure, and conform effective working of thermostat.

Dyeing time:
Dyeing time is kept as per the previous records in record book. Ensure desired holding time for the dyeing. Rapid jet takes 1 hour, old jet and beam take 2.5 hours, soft flow also takes 2-2.5 hours for completion of dyeing.

Vessel Pressure:
During dyeing, pressure gauge reading on jet should be 25psi, for soft flow it should be 20-25 psi. So ensure optimum pressure.

JIGGER DYEING MACHINE:

Fabric preparation:
POINTS TO CHECK: Absorbency, whiteness, pH of core fabric, creases of the fabric and the selvedges.
STANDARD: Uniform whiteness, Ph must be neutral, and fabric should be crease free.
NECESSARY ACTION: Give two acetic acid or formic acid wash. If the absorbency is not proper then rescouring is to be done. If uniform whiteness is not there then segregate the fabric. If creases are there then pass through the stenter to remove the creases.

Batching:
STANDARD: Knife cut batching (very even batching). If batching is not even, then segregate the fabric or dry the fabric on the stenter. During batching another precaution is that the expanders of the jigger must work properly.

Batch Size:
Indian machines are having batching capacity in kg but internationally, diameter of the batch is specified.

Measurement of the yardages of the fabric:
STANDARD: It is the maximum permissible limit.

Maximum Limit:
Do not permit to overload the fabric. Because the fabric may get overlapped.

MLR:
Jigger dyeing machine is 1:1 to 1:1.5**.** During colouration 1:1.5, during soaping 1:2, during soaping for overflow washing it is 1:5. Maintain constant water level for over flow washing. Prevent water and steam leakages.

Quality of the end cloth fabric:
Non absorbent like nylon, polyester, linen etc. Length and width of the end cloth needs to be checked.

Crease free fabric:
Creases are found near the selvedges. So it has to be removed immediately. Creases are formed in between the fabric due to the improper working of expanders.

Recipe:
Calculated according to the weight of the fabric and the quality of the fabric.

Colour Preparation:
Checked during the preparation of the colour. Check on the filter paper by spotting. Ensuring proper dissolution of the colour. Strain the colour through bolting cloth prior to dyeing. This parameter is for conventional jigger machine.
Use proper dissolution method in case of vat and sulphur, give sufficient time for dissolution.

Colour and Chemical Addition:
Importantly colour and chemically addition should be in even installments and not in odd installments. Use of splash board should be done during addition of any chemical to the jigger dyeing machine. Proper stirring of the solution in the trough after every addition. All solid chemicals must be added by pre-dissolving.

Concentration of Chemicals:
During dyeing optimum amount of chemicals should be used and there is no standard for it.

Temperature:
During dyeing with the help of the thermometer check the temperature and the standard of temperature should be as per the class of the dye. Regulate the heat supply. Heat the solution during the end of the turn and not in between when an end[1] is running.

pH:
Check pH during dyeing as per the class of the dye. Give optimum dose of alkali and acids in the trough.

Addition of colours for the correction of the shade:
Ensure that addition must be done in the jigger by draining half quantity of trough solution. The reason is that the new dye requirement to set the shade right will be less as the dye initially present has reduced to half the quantity plus in addition there will be shift in equilibrium and hence dyeing will again start and lead to shade correction.

After treatment:
In case of after treatment in sulphur dyeing i.e. after oxidation Sodium acetate and pine oil treatment is given to avoid bronziness and tendering. In case of Disperse dye Reduction Clearing is given. In case of Direct dye dye-fixing treatment is given.

PROCESS PARAMETERS FOR SEMI-CONTINEOUS AND CONTINEOUS METHODS:

Fabric Preparation:
Check even absorbency and fabric should be crease free. For semi continuous the width of fabric is more

1End: It is a terminology used in jigger dyeing machine, where in an 'end' means transfer of full fabric loaded on one roller of jigger machine through the liquor to the other roller.

important as it is rolled. Proper stitching of fabric is required. Heavy stitches should not be there. Fabric should be uniform and even in absorbency. Uneven width pieces must be segregated.

Nip Pressure:
In nip pressure, the padding roll and squeezing roll are to be checked.
METHOD: Roller pressure is measured by taking % expression. Hardness of the roller is checked by degree shore meter or by carbon expression test. Polishing of the soft roller is done to adjust the pressure. Proper working of hydraulic and pneumatic pressing device is checked for.

Threading of the fabrics:
Threading must be checked during drying, padding and soaping.

Expanders:
During dyeing, expanders are to be stretched. Proper working of ball bearing should be checked for. Proper and regular greasing and oiling should be done for proper working.

Guide Rollers:
During dyeing, ensure smooth working of guide rollers.

Colour Preparation:
Checked during the preparation of the colour. Check on the filter paper by spotting. Ensuring proper dissolution of the colour. Strain the colour through bolting cloth prior to dyeing. This parameter is for conventional jigger machine.
Use proper dissolution method in case of vat and sulphur, give sufficient time for dissolution.

pH:
Check pH during dyeing as per the class of the dye. Give optimum dose of alkali and acids in the trough.

Speed:
Speed is measured with dial speed meter. Maintain optimum speed for dyeing.

Dwell Time:
During dyeing, the dwell time is checked with the stop watch. Adjust the speed to get uniform dwell time.

Temperature of drying chamber:
Ensure slow and uniform drying to avoid migration of the colour.

Flow of feeding liquor:
Flow of feeding liquor has to be adjusted with the flow meter. Adjust the flow such that the liquor should pass throughout the width and length of the fabric.

Batching for semicontineous Process:
Avoid over batching. Batch must be revolving to avoid the seepage. For continuous dyeing range the fabric must be cooled before batching.

Covering Batching:
For pad batch and semi continuous method the fabric is to be isolated from the departmental atmosphere.
NECESSARY ACTION: Wrap the batches with polyethylene sheets to avoid localized drying.

CHAPTER 4

PROCESS PARAMETERS FOR PRINTING:

Fabric preparation:
Crease free, singeing, uniform whiteness(WI), cleanliness of fabric, width of the fabric, hairiness of fabric (luster meter), absorbency(drop test), pH of extract of fabric(pH indicator), Face of the fabric.

Gum preparation:
Viscosity(Viscosity meter), pH(pH paper)**,** Viscosity in flatbed is kept more and less in rotary.
NECESSARY ACTION: Check easy flowing of paste to the adequate time and temperature, ensure preparation of free flowing gum and paste should be lump free, for that purpose if lump are there then strain the paste.

Colour Preparation:
Ensure the pH of printing paste and shade of the print dots.
NECESSARY ACTION: Adjust the pH according the class of the dyes and shade as per the standard.

Design Checking:
Check no of screens as per the no of colours. Check Fitting of all design and matching's are matching with each other or not. Check with sample printing. Check individual screen for pin holes and patch it up and check it on glass table with tube light.

Expanders and guide rollers:
Crease free flow of the fabric with smooth working of guide rollers.

Squeegee pressure:
Here visually the squeegee pressure is adjusted. Necessary action is maintaining uniform squeegee pressure from selvedge to selvedge.

Cleaning of Rubber blanket:
Blanket must be completely dried and completely clean.
NECESSARY ACTION: Checking of effective working of cleaning device of blanket.

Crease free drying:
Check smooth working of drying fans from the drying side. Synchronization in blanket speed and drying speed is to be checked.

Stability in printing paste:
Before printing the stability is checked for sample printing.
NECESSARY ACTION: Enrich the print paste with required ingredients to take care of depleted strength.

Left over print paste:
Left over is checked and % remaining is checked, It should be less than 5% in latest machine and less than 10% in case of the conventional machines. Ensure proper recording of actual print paste consumption of al l the machines and effective reutilization of left over print paste.

FIXATION:

PROCESS PARAMETER FOR POLYMERIZATION:

Temperature:
During polymerization method of checking is dial thermometer.
STANDARD: Temperature must be uniform.
NECESSARY ACTION: Ensuring adequate and uniform temperature.

Time:
During polymerization time of contact is checked with stop watch. Time is 3-6 minutes.
STANDARD: As per the requirement.
NECESSARY ACTION: Maintain proper speed and check crocking fastness. For synthetic fibre fabric, if overtime is there, then the fabric will shrink and if less time is there, then the crocking fastness is reduced. So maintain proper speed.

Exhaust:
While Polymerizing, exhaust of stenter should be taken care as it can lead to fire if proper exhaust is not taken care off as the oils are flammable in nature. For coarse print 30-35% exhaust of the input hot air and 20-25% in case of fine print is kept to optimize the exhaust. See that exhaust fans work mainly for pigment printing when kerosene is used.

Free movement of guide rollers:
Free movement is checked for crease free run of the fabric. Check it visually.

AGEING:

(Ageing is introduction of steam over fabric at normal Temperature and pressure).

Time & Speed:
5-7 minutes, in loop ager.
STANDARD: As per the requirement and maintaining the speed as per the requirement time of contact.

Guide Rollers:
PRECAUTION: No crease should be formed over the fabric.
NECESSARY ACTION: Ensuring crease free flow of the fabric.

Water Level:
Some units are using conventional type of machine. Level is to be maintained or proper steaming will not take place.
STANDARD: Maintain optimum water level.

Acid injection during ageing:
Ensure optimum quantity of acid injection.

Steam pressure:
During ageing steam pressure is checked with the help of pressure gauge as per the requirement.
1.5-1.75kg/cm^2
ACTION: Regulate the steam supply.

Condensation:
STANDARD: No water droplets on the roof.
ACTION: Roof is heated with steam jacket, so check proper steam supply.

Marking off:
During ageing in batch type of machine, there is backgrey fabric used in between two layers of the fabric. Because of its continuous use it gets stained and when very light quality of printed fabric is aged the stained backgrey fabric transfer its stains to the printed fabric.
STANDARD: No marking off.
NECESSARY ACTION: Check and change the backgrey fabric and continuous cleaning of all guide rollers is to be done.

CARBONIZING & SOAPING:

For carbonizing:
Checking concentration of sulphuric acid. Here titration method is preferred. Standard is 71-72% H_2SO_4. So maintain proper concentration of sulphuric acid.

Checking of Nitrogenous impurities:
Brown ring test is the method used.
ACTION: Addition of urea or sulfamic acid in the bath neutralizes the nitrogenous impurities.

Dwell Time for carbonization:

METHOD: With help of stop watch.
STANDARD: 45 minutes. Ensure optimum dwell time.

Carbonizing efficiency:

MEHTOD: Carried out by laboratory analysis.
STANDARD: It should be more than 99% actual standard is 99.7%

ACTION: Change the acid, Check the concentration.

Neutralization:

MEHTOD: With help of pH indicator. The fabric should be near neutral. Ensure complete neutralization of the fabric. Generally sodium carbonate is used. When Sodium carbonate is used some precaution is required as it can affect polyester as the heat may rise in the bath due to heat of neutralization as well as the exothermic reaction due to addition of alkali to water.

Local Drying:

STANDARD: No local drying. To avoid the local drying increase the pickup of acid, and avoid undue exposure.

Soaping:

WATER JET: No chocking of water jets should be the standard.
ACTION: Clean all water jets after every lot and ensure proper functioning.

Water Supply:

Soaping is always dependent on water supply. During soaping or washing check the water supply.
STANDARD: Here no specific standard exists. Depending on the quality and as per the method of soaping it is decided. Maintain optimum water supply to every washing box and initial two wash boxes must give overflow washing.

Threading:

Threading is dependent on the make of the machine manufacturers.
NECESSARY ACTION: Stretch formed over the fabric should not be more to distort the fabric.

Guide Rollers:

During process it has to be checked and ensuring smooth working of guide rollers to get crease free flow.

ACTION: Check the alignment of the guide rollers. Every roller must be parallel with each other.

Squeezing pressure:

Squeezing pressure must be uniform and ensure uniform squeezing throughout the width and maintain softness of squeezing roller

Temperature:

Temperature is measured with the help of the thermometer. Temperature must be uniform as per the quality and treatment.
NECESSARY ACTION: Regulate the steam supply to maintain the temperature.

Concentration of Chemicals:

Any suitable testing method such as titration, solid contents etc.

STANDARD: No standard for it, just find out the optimum concentration.

CHAPTER 5

PROCESS PARAMETERS FOR FINISHING DEPARTMENT:

STENTER:

Nip Pressure:

Study is done by pick up study.
STANDARD: It should be uniform though out the width and length. To get the uniformity the necessary action is to check the surface of padding mangle and adjust the pressure (Pneumatically or Hydrolytically)

Bow and Heading (Skew) Controllers:

During process the method is visually.
STANDARD: No bow or heading in the fabric.
NECESSARY ACTION: To check the proper working of photo cell. Check the synchronization of photo cell and heading and bowing rollers. Check the hardness of bowing rollers and alignment of bowing rollers.

Chamber Temperature:

Method of checking is dial or digital thermometer.

STANDARD: As per the process and quality. Necessary action is to regulate oil supply in the radiator, check proper functioning of solenoid valve and digital controls.

Dwell Time:

During process with the help of the stop watch, dwell time is depend on the quality and time of process and according to that the necessary action is to regulate the speed of the fabric.

Overfeeding:

More fabric is feed to the stenter than the speed of the fabric during drying.

If the shrinking is to be done in width wise direction then the chains are kept closer and are not stretched.

METHOD OF CHECKING: To check % over feed marking on initial cloth is done and it is measured after the process.

ACTION: Measure the optimum overfeed at the time of heatsetting.

Underfeeding:

Speed of the fabric feed to the stenter machine should be less than the output. This is done to increase the length of the fabric.

Expanders and Uncurlers:

During the process, usually the working of uncurlers is to be checked. Pneumatic uncurlers and mechanical uncurlers are used.
STANDARD: There should be no creases on the fabric.

NECESSARY ACTION: See that the uncurlers are in smooth working condition, and smooth revolution of the expanders is there.

Blower:

Blower during the process is to be checked.

STANDARD: Proper air circulation, and for proper air circulation.

NECESSARY ACTION: Clean the air filters. Check the direction of fan. Air is to be taken from out to in.

Width of the fabric:

Width is decided by the distance between the chains and it is to be checked at the delivery end.

Ensure proper working of width adjusting shaft.

Thermic fluid leakages:

STANDARD: No leakages should be there. We come to know about the big leakages when there is some brown spots on the fabric. If many small brown spots are seen it means there is small leakage because fluid falls as a spray.

Concentration of the Chemicals:

List the chemicals and the concentration of the chemicals.

NECESSARY ACTION: Maintain required optimum concentration. Higher concentration of the chemicals will lead to white effect when scratched with nail which is called as a chalk marks. Chalk marks will be there when concentration will be more.

Stability of Precondensate Resin:

Prior to finishing the stability is checked. Precipitation is checked by time study visually.

STANDARD: No precipitation or inactivation. Ensure proper stability of the recipe. Then select all the finishing chemicals which are compatible with each other. For resin finish select precondensate resins.

Temperature and viscosity of the finishing bath:

Temperature for starch based product is to be kept constant. During the finishing it is checked with the thermometer.

STANDARD: To maintain uniform and optimum temperature according to the starch.

Drying Efficiency:

It is checked during and after the drying process. Now a day it is checked with conductometer i.e. by help of transducers.

STANDARD: No over drying of the fabric or else it will lead to high energy consumption and strength loss. Drying efficiency of 95-98% is expected.

Temperature of Thermic fluid oil:

It should be checked during the process with digital thermometer and it should be optimum

STANDARD: Regulate thermic fluid circulation.

Random inspection of clips and pins:

This is checked before the process.

STANDARD: Pins and clips should be working. Ensure proper working of the pins and clips.

SANFORIZER:

Damping:

Damping is done by sprinkling water over the fabric prior to stretch. It is checked by the conductometer.

STANDARD: It should be optimum. The fabric should not be wet, it should be damp. Adjust the spray intensity.

Temperature:

Without temperature there is no possibility of shrinking. Check temperature by thermometer or digital thermometer. The standard range is 140-160^{0}C. Regulate the steam supply to get required temperature.

Width of the fabric:

After shrinkage the width of the fabric is checked at the delivery end. Width measurement is done by tape. Adjust dwell time and % shrinkage. During preshrinking the speed is generally kept in range of 20-40mpm.

NECESSARY ACTION: Adjust speed uniformly throughout the batch.

Belts and Blankets:

The sanforizer belt is made up of rubber and the blanket which is a part of palmer unit is made up of wool. Prior and during finishing check the surface of belt.

STANDARD: It should be smooth in the surface. Ensure correct surface of the belts and blankets by regular grinding.

Shrinkage:

After preshrinking the shrinkage is measured as per the stenter already discussed.

Pulling water nozzle:

Water is for protecting the belt. As the belt is in constant contact with the heated roller so it must be cooled. The belt should be cooled till room temperature and in continuous running it should not be more that 15-20^{0}C higher than room temperature.

STANDARD: It must be always cool. Check chocking of any nozzle heads.

CALANDER OR SHRINER:

Nip Pressure:

Effect depends on the nip pressure. It is generally 7-9 Tons on the rollers. Prior and during the process it is checked. Method of checking is, nip pressure reading. Check the compressor valve or pneumatic control valve.

Threading:

This is done before calendaring. It is checked visually.

STANDARD: As per the finish to be obtained. Ensure proper threading to the finish.

Damping:

This is before calendaring. It is checked with the feel of the fabric, or with the conductivity meter.

NECESSARY ACTION: Adjust water spray intensity.

Speed:

Speed is checked during the process with speedometer.

STANDARD: There is no standard but 40-80mpm is used.

NECESSAR ACTION: Regulate speed.

Width of Fabric:

It is checked during process with the tape measurement as per the sort or quality of the fabric. Ensure desired width at the delivery end.

Roller Surface:
Prior to process it is checked visually.

STANDARD: No cracks to the soft rollers, any holes or rough surfaces or deposition over the roller.
NECESSARY ACTION: Ensure proper cleaning of calendaring rollers. Here the process control parameters are completed.

CHAPTER 6

QUALTIY CONTROL PARAMETERS

GREY ROOM:

Under ultraviolet light mineral oil will look violet, vegetable oil looks yellowish in colour. Metallic soaps show yellowish brown shades. If uneven FBA's are there on the fabric it is also detected. Mildew growth shows bright yellow colour. Metals trace like Fe, Cu, lead shows very dark areas against lighter background. For metallic stain the quality control test is as follows.

The fabric is washed in the HCl acid, and Potassium ferrocynate or Pottasium thiosynate, in the presence of iron. Ash content will give red brown colour.In presence of copper the solution becomes dark blue. In presence of both the metal ions the solution becomes greener.

Different Tests to be performed:

- Absorbency.
- Weight loss.
- Oxycellulose Formation.
- Copper Number.
- Carboxylic Content.
- Ash Content.
- Wax content.

BLEACHING:

Drop test:

Fabric is kept 5cm from dropper, 1 drop of distilled water is put on the fabric under a bulb. If bulb is not seen in the drop then stop watch is stopped. Minimum 20 tests are carried out and average is taken.

Sinking water test:

Pieces of 1cm by 1cm of fabric are kept on the solution. The time the pieces float on the surface of the water is noted. Fabric first absorbs the water and then swells and starts dripping.

Wax content:

For this test, soxlet apparatus is used. Air dry the fabric and take its weight and then take final weight. If any different is there in the weight then there is wax content. If no difference is there then there is no wax content.

Ash Content:

It is inorganic analysis test. Known weight of sample is burn over the crusible and heated till white ash is seen. Then take the weight and find out the % of it and it is compared to the fabrics original weight. It should not be more than 0.5%. White means silicate content, red means iron, dark brown means copper is present. Ash is dissolved in ferrocyanate as above.

Weight Loss:

Initial weight and final weight after the treatment is taken and then calculated as below

Final weight x 100/ Initial weight. The norm is less than 4%. Test is to be conducted at same parameters.

MERCERIZATION:

Principle of Barium activity number:

Mercerized cotton absorbs more Barium hydroxide then the unmercerized. As accessible region generates in the cotton, BaOH as an alkali will penetrate more in the fibre. Phenolphthalein is used as an indicator. Here the well mercerized fabric gives Barium number in range of 150-160, yarn may give upto 180 that is highest. But in practical in fabric 120-130 is achieved, pad chain gives 140, in case of padless chain less when two fabric are done simultaneously BAN is 100-110.

Deconvolution count:

5 samples minimum and 10 samples maximum of fibre are taken out from yarn without breaking the yarn. Unmercerised fibre is observed in Microscope and after mercerization also it is seen. Deconvolution % in pad less chainless is 50-60%, in pad chain it is 40-50%, in yarn it is 20-30%.

Luster Meter:

Luster meter is a special device in which the sample is placed and direct value is obtained on the digital display.

Cross Section:

Cross section ratio must be very near to one. In Yarn 0.8-0.85, Pad chain 0.75-0.78, pad less chainless 0.7-0.75.

Dye ability:-

The dye ability of the mercerized goods increases

Moisture regain:

Orientation and development in cuboid position of cellulose.

QUALITY CONTROL IN HEAT SETTING:

Shrinkage Test:

In heat setting the first test which is carried out is shrinkage test. Shrinkage test are of two types.

1) Hot air 2) Boiling water test.

Hot air shrinkage test is carried out if the fabric is to be subjected to hot air treatment in future.
STANDARD: For Hot air the fabric should not shrink more that 1%.
For boiling water test the tumbler MLR is 1:50, Time is 30 minutes at boil.

Iodine test:

Iodine absorption test is for 100% Polyester and Polyester blend. Exactly weigh 1gm of sample (in the blend consider the wt of polyester only). It should be nearly 1gm. Take sample in 250ml stoppered flask. Add 30ml 0.1N iodine solution. Iodine solution must be phenolic (12.7gm of iodine, 20gm of potassium iodide, add 100ml of acetic acid and 350ml of Phenol at 60^0C and dilute the content to 1 liter at room temperature. Keep the sample in prepared iodine solution for 2 hours at room temperature. Then transfer the sample in splitted glass crucible and wash thoroughly with distilled water till free from iodine. Then washed samples are transferred to 250ml conical flask, containing 50ml chloroform, (Chloroform is a swelling agent for polyester). The absorbed iodine by the polyester is transferred into chloroform, then add 10ml of 0.01N of Sodium thiosulphate, and titrate against 0.01N iodine solution, using starch as an indicator. Simultaneously carry out blank titration. The absorption of iodine is calculated in milligram/gram of fibre.

$[(x-y)x0.01x127]/W$

X is iodine for blank, Y is iodine required for sample, w is weight of sample

To get reproducible results always maintain same test temperature.

DYEING:

Fastness:

Washing fastness, perspiration fastness, rubbing fastness, scrubbing fastness, light fastness, seawater fastness, pool water fastness, Sublimation fastness, Hot press fastness, fastness to saliva, Chlorine fastness, Gas fading etc are different fastness test for colour.

Colour change is measure by grey scale method. Staining is measured by adjacent fabric.

10-4 cm sample dyed or printed is sandwiched between two adjacent fabric which are undyed or unprinted with the same material. For blended fabric predominant blend is taken for sandwitching or multifilament fabrics are used for sandwitching. The sample must be 3mm smaller from all the 4 sides. All 4 sides are stitched on stitching machine and then the suitable test is performed. For change in the colour, after opening the sample it is dried in shadow and carried out the colour change without washing. For staining adjacent fabrics are dried in shadow without washing and used for staining scale. The viewing condition for both the samples is in colour cabinet and the observer must be at 45^0 angle and the light source used is D65.

Evaluation of staining:

Fastness to washing:

In case of IS (Indian Standard) five different method are there.

Test Name	Concentration	Temp and MLR	Time in Mins	Remarks
IS 1	5gpl Soap	Test is carried out at 45^0C with MLR 1:40	30	
IS 2	5gpl Soap	1:50 at 50^oC	45	
IS 3	5gpl Non ionic neutral soap, free from OBA + 2gpl soda	60^0C	30	
IS 4	5gpl soap + 2gpl soda	95^0C	30	Add 10 stainless steel balls having 1.5gm weight, in the vessel.
IS 5	5gpl soap + 2gpl soda	95^0C	4 Hrs	10 stainless steel ball as above.

Fastness to perspiration:

There are two type of human perspiration i.e. Acidic and Basic. Perspiration is prepared by using L,hystadine monohydrochloride, monohydrate at concentration of 0.5 gpl + Sodium chloride 5gpl.

For acidic perspiration Disodium hydrogen orthophosphate dodecahydrate is taken at 5gp and pH is adjusted to 5.5 with acetic acid.

For basic perspiration Sodium dihydrogen orthophosphate dehydrate is taken at 2.2 gpl.

pH is adjusted with 0.1N NaOH.

Here sample is sandwiched in the adjacent fabric, there it is clipped into the glass plates, and keeping under weight of 4.5kg for 4 hours, 38^0C +- 1^0C is the temperature, maintained.

Fastness to hot pressing:

It is carried out in two ways. Hot pressing and wet pressing. In case of wet pressing, sample and adjacent fabric is dipped into water and it is kept in filter paper to remove excess water from fabric and a test is carried out. Pressure given on the fabric is 30gm/cm^2. Test is carried out at 100^0C+-2^0C, 150^0 +-2^0C and 200^0 C + -2^0C. For every test time allotted is 15 sec. All three samples are heated from top. One side is electric heated and adjacent fabric is kept to the opposite side of the sample. Sample is analyzed for the change in colour and staining on the adjacent fabric. Some times for the adjacent fabric multifilament fabric is taken whenever the blend is present.

Fastness to Sublimation:

This test is mainly carried out for polyester and its blend for disperse dyes particularly to check the tendency of migration. The test is carried out in scorch tester. It is similar as hot pressing but slight change with heating with both the side of the fabric, where both the plates are electrically heated. Fabric is sandwiched in same kind of undyed blend fabric or 100% polyester, and kept in the sublimation tester and treatment is carried out for 30 seconds at temperature 150^0C, 180^0C and 210^0C. The sample is checked for the colour change and the adjacent fabric for staining change.

Rubbing Fastness Test:

Rubbing test is generally carried out in Pigment, vat, reactive, acid dye etc. The fabric is clamped on the rubbing fastness tester. The white fabric approx 5cm is clamped on the finger of tester. The probe is moving against the specimen in 10cm distance for 10 times to & fro with one to & fro stroke at speed of 1 sec. Probe is having a 900gm load. Then rubbing fastness is calculated by staining scale method by checking the fabric clamped on the finger. In case of the wet rubbing test the fabric on the probe is wetted and same procedure as above is followed.

Fastness to wet scrubbing:

This test is only for pigment dyed fabric. The sample is same as the rubbing fastness test. Instead of rubbing device there is a scrubbing device (metallic wire brush with 250 wires/sq inch area with length 5mm. Weight is 100gms, which is fitted with a brush. The specimen is dipped in the 5gpl soap and 2gpl soda ash at 60^0C and then generally 100 Strokes are given. After 50 strokes the sample is again dipped in the soap and soda solution and again it is scrubbed. Then the sample is washed and dried in shade and change in colour and change in depth is evaluated.

Light Fastness:

Fastness for light is generally carried out for all types of dyed and printed fabrics. The artificial lamps which have same intensity of Sunlight are selected. Mainly Xenon lamp is used. This test is carried out from scale 1 to 8. For this purpose 1-8 different wool samples which are called as know blue wool standards, having known light fastness properties. During the exposure the precaution is taken to maintain temperature in and around the sample 30^0C. For that water cooling systems are used to

maintain temperature and humidity in fadometer. All blue wool samples are exposed along with specimen. Time of exposure is from 24hrs – 72 hrs. After the exposure time, complete change in the colour of specimen is compared with change in the blue wool sample. E.g. If 5 number blue wool sample colour change is equivalent to the specimen sample then light fastness rating is 5.

FINISHING:

Quality control for finishing is very difficult.

NAME OF FINISH	QUALITY CONTROL MEASURE	REMARKS
Mercerization, or application of binders or fillers.	Tensile strength (Warp and Weft way), Tear Strength	Strength will maintain when temperature control is there during finishing.
White fabric.	Whiteness and yellowness on CCMS.	Compare with any known standard.
Whiteness retention.		Whiteness retention should not be more than 10%.
Temporary Finishes (Softness, stiffness)	Handle (Drape test), Feel by Kawabata, Shine or lusture by lusture meter.	All samples compared with the standards
Antistatic Finish	Conductivity meter (Honestometer)	
Pre-Shrinking	Residual Shrinkage (Boiling water test)	
Anti-Pilling	Pilling testing or Abrasion	
Resin Finish	Crease Recovery angle, Tensile Strength, Tear strength, Free-Formaldehyde	
Water Repellent	Spray test, Hygrostatic pressure test.	
Flame Retardant Test	Vertical flammability test. Cigarette burning test.	

The main aim of finishing is to give aesthetic value to the fabric with required properties. Any functional finish according to the need is taken for different quality control test. From the above table one or more than one quality control test may require to maintain the quality of the fabric.

The main function of the quality control is reduction of damage in wet processing at reduced value loss with minimum reprocessing. Various possible defects that may arise during wet processing must be analyzed according to the probable defect and suitable quality control test is performed. The responsibility of quality control is not only to perform the test but interpreting the test results. Therefore quality control personnel should not only be thorough in theoretical knowledge but also he requires practical aspect of that process.

CHAPTER 7

ELECTRICAL HAZARDS:

These are classified into

1) Electrical shocks.
2) Electrical burns.
3) Electrical fires and explosions.
4) Other hazards due to injuries caused due to electrical accidents such as heat, falls, and striking against.

ELECTRICAL SHOCKS AND ITS CAUSES:

It can be due to when both the wires of the electrical supply or one wire which is energized and another is ground comes in contact of a human being. Shock can also be received when an energized metallic part comes in contact while standing on the ground. The severity of the electrical shocks is mainly dependant on the amount of current passed through the body, path of the flow, period of the flow, nature of the current, frequency of the current and the resistance offered by the body.

CAUSES:

Insulation failure:

It is due to overheating of the conductor, conductor coming in contact to hot surface, presence of moisture, mechanical damage, insects ageing, etc.

Equipment failure:

It is due to failure of components in switch gear assembly, breaking of insulator, corrosion fatigue, cable failure, poor maintenance, insulation resistance of electrical equipments, cables and earth connections etc is poor.

Dielectric strength of oils in transformer:

Accumulation of dust and dirt, substandard equipments and workmanship, selection of proper and standard material (ISI), Equipments must withstand to system pressure and design load, proper installation of equipments and cable terminations.

Unauthorized personnel:

Installation, repairs and maintenance of electrical insulation should be carried by qualified and authorized personnel only.

Lack of training and knowledge:

Person must have adequate knowledge and safe use of electricity and proper training to handle the equipments.

ELECTRICAL BURNS AND ITS CAUSES:

Contact burns:

It is caused due to heating effect of electricity. They are not that serious but they may cause burns of internal organs. Macrosis tissues which are under the skin get burned along the path of flow of current and can lead to severe aftereffects.

Flash or arc burn:

Arc burns are generally received from flash over's, in particular with high voltage. In particular arc burns are far reaching and victim may get bodily scared or may lose a limb. Flash over are generally generating in switch gears, panels, transformers etc. The additional hazard is due to the gases and smoke given off.

Scattering of vaporized Metal:

Flash over's and arcs are accompanied by scattering of hot vaporized metal. The hot metal globules may impinge and get embedded deep under the skin. When an open fuse blows or conductor fuses, the metal like silver, copper, tin etc gets vaporized and gets deposited on body of person exposed to arc.

Arc eye and metal fume fever:

The radiations emitted from the arc may affect the person causing sever eye pain. This disease is called arc eye. This is very common to welders, because the arc is generating the UV rays in more extent. But at the same time the metallic fumes generated by welding by the welding personnel give metal fume fever. It is leading to heavy suffocation, and damage of lungs. It can be minimized by the proper ventilation.

ELECTRICAL FIRES, EXPLOSIONS AND ITS CAUSES:

Over loading:

Whenever the current carrying conductor is subjected to the flow of current beyond its rated capacity the conductor gets over heated. Insulating materials are generally combustible at specific temperature.

Due to overheating of conductor they catch fire and spreading of fire becomes rapid when the wiring is run through the entire building.

Incorrect Fuses and protective devices:

Over loading may cause due to incorrect connection of fuse or wrong setting of protective devices. Over loading may cause due to incorrect selection of fuses. The incorrect fuses may cause fusing of the conductors or damage other devices which are supposed to be protected. Wrongly set protective devices may also cause overloading of the insulation and the equipments.

Poor Maintenance:

The poor maintenance of the electric insulation is responsible to carry noncurrent metallic parts. But also can cause fires and explosions. The terminal connections of switch gears or a panel or cable box may lead to overheating, sparking and busting if it is not attended properly. The periodical inspection and cleaning of contactors may minimize this hazard.

Explosive Atmosphere:

Electricity has been a cause of many explosions in hazardous atmospheres involving flammable liquids and vapors. In this atmosphere if adequate care is not taken the electricity can be a source of ignition, due to hot surface of electrical equipments, spark discharge, etc.

OTHER HAZARDS OF ELECTRICAL ACCIDIENTS:

1) Due to the violent jerk aftershock person may fall, and there may be an injury.

2) Person who are working on overload, may get magnetically affected by which his hypertension may affect.

3) The flammable vapors due to explosion may affect the respiratory system of personnel. The hot oil splashed out as a result of bursting can also cause serious burns.

PREVENTION OF ELECTRICAL ACCIDENTS:

1) Provide proper and double earthing to electrical equipments. Due to minimum earthing resistance offered by copper the leakage current pass easily through it and not through a person. Hence copper wire is used. The earthing should be periodically inspected, tested and maintained properly.

2) Use of approved insulated tools, rubber mats, shock proof gloves, shoes, tester fuse puller, discharge rod, safety belts, hand lamp, wooden or insulated ladder, chain etc should be made use of.
3) Avoid temporary wiring.
4) Employ trained electrician.
5) Better insulated and tested wiring.
6) Isolation of machine, equipment before use.
7) Work permit system should be followed, when working in switch yard or control rooms.
8) Safety tags and safety working notices.
9) Use of machine or equipments within their limits i.e. no over loading.
10) Ancillary room, battery room and control room to be separated.
11) Two exits to each electrical room.
12) Guards on transmission lines to prevent faults due to birds.
13) Dustproof indoor switch gears.
14) Use of protective relays, circuit breakers, rated fuse controls and to isolate the faulty equipments speedily and automatically. Record of ground resistance values and the physical condition of insulating mats.
15) Temperature sensitive alarms and protective relays to make alert and disconnect the equipment before overheating.
16) Interlogs are put into an out of service equipments.
17) Testing of high voltage, timing and insulation resistance.
18) Cleaning and application of silicone grease to insulators.
19) Safe cable stretches and preferably armored cables.(through sand layer)
20) Transformer with oil safety, fuses, and fire protection systems.
21) Generators and motors with fire proof doors, automatically operated by fire detectors.
22) Provisions of CO_2 and other type of fire extinguishers.
23) Double communication systems with critical areas.
24) Clear approach for firefighting squad.
25) Good housekeeping including well maintenance of all electrical insulations.
26) Adequate working space and means of access around each apparatus.
27) Provision of first aid box and respiratory equipments.
28) Prevent higher humidity and temperature near electrical equipments.
29) Work with full protection in raining.
30) Use of flameproof equipments in flammable and explosive areas.

REASONS FOR ACCIDENTS:

One of the surveys conducted pointed out that being 1 visible accident there are 30 near misses and 300 unsafe acts/unsafe conditions.

UNSAFE ACTS:

Workers are mainly responsible for unsafe acts. Unsafe acts mean clear violation of commonly accepted safe working methods. There are number of reasons why workers act unsafely.

1) **Physical handicap/Mental handicap:**

   A person with a balanced mind in a balanced body generally does not indulge in unsafe acts. But some employees are physical and/or mental handicap. Such persons usually do not maintain safe working methods all the time and thus invite accidents.

2) **Lack of knowledge about process/machines:**

   It is a basic need for any employee to understand his process/machine thoroughly from safety point of view. Management must ensure this. In case of failure from management or employee in meeting this need then unsafe act will happen time and again.

3) **In sufficient skills:**

   In addition to understanding the process and the machine any employee should acquire necessary skills for the job concerned. Different jobs require different skills. Without such skills employees cannot guarantee safe acts all the time. This fact must be considered while engaging substitute workers or while changing the job contents of any permanent worker. Substituting man for man is not a wise policy to follow. It has been observed from the past records that many accidents have happened because of persons with inadequate skills.

4) **Inadequate training:**

   Instituting training culture in the organization is the responsibility of any management. It must be clearly understood that training is not needed only for fresh entrants. There is need to have refresher training also. Again, management should ensure that expected results are being achieved from training and re-training activities.

5) **Making mischief's at work place:**

   Tendency of the employees to do mischief, play jokes at the working place must be totally curtailed. Such behavior will totally nullify the effects of imparting knowledge, skills etc. In the past many serious accidents have taken place due to such mischief.

6) **Over confidence:**

   Some employees are over confident about their skills and capacity to perform. They carry the belief that they can pass through any adverse conditions without getting affected. Because of

such over confidence they intentionally keep aside safety rules and procedures. The results speak for themselves.

7) **Impatience:**

Many employees lack in patience. They become impatient with the passage of time and in hurry take unsafe steps which in normal course they would not have taken. Importance of patience must be stressed to all the employees to control accidents.

8) **Undue Hurry:**

When any employee fails to manage his time properly he is forced to hurry up in carrying out his duties. Under such situation many times he indulges in unsafe acts.

9) **Excessive fatigue:**

With excessive physical and or mental fatigue any person losses his reception power. His reflexes also get poorer. This often leads to unsafe acts.

10) **Indifference/ Apathy:**

Many persons rely more on their fate than on themselves. Their ideology is 'if accident is destined to happen it will happen. Why should we bother for safe/unsafe practices?'

Such indifferent attitude of the employees is very risky for the organization. If number of such indifferent employees is more in any organization accidents are prone to happen.

UNSAFE CONDITIONS:

1) **Unsafe process/machine:**

Various processes/machines are involved before fibres get converted into a finished fabric. Some of these processes/machines are hazardous in nature due to:

Toxic materials,

Abnormal temperature,

Abnormal pressure,

Sharp parts,

Inaccessible parts,

Very close setting between moving parts etc.

Chances of accidents are very higher on such machines/processes.

2) **Improper working conditions:**

Improper arrangements at the working place make the conditions unsafe for work. Inadequate illumination and/or ventilation make working accident prone for the employees. Similarly unscientific layout of the machines narrow access alleys, slippery flooring, improper designed stair cases and ramps make working difficult and risky.

3) Inadequate safety tests:

Wide range of machinery is being used in our textile industry. Compressed air is being extensively used on these machines. High temperature , high pressure machines are in use in chemical processing. The concerned cylinders, flanges valves, ducting, piping etc, must be tested for safety from time to time. They should be able to withstand the corresponding temperatures and pressure. Any negligence in this aspect can prove disastrous.

4) Improper maintenance of safety devices:

Machinery manufacturers usually provide safety valves on all machines. These are expected to act when the inside pressure tends to increase beyond pre set value. There by the pressure drops down and accident is prevented.

It is necessary for the management to maintain these safety valves in proper working condition. Many accidents have been reported because of the faulty functioning of safety valves.

There are also cases where safety alarms are provided. Such alarms give warning to the concerned employees about the ensuing accident. There by employees can take necessary corrective measures to minimize losses of men, machine and material.

A separate system should exist in any organization to ensure trouble free working of safety valves and alarms.

5) Improper material handling:

It is the responsibility of the managements to provide suitable material handling equipment. The idea should be to safety handle the material without excessively taxing human beings. Neither the material should get damaged nor should human being get excessively tired. Neglecting this aspect may lead to accident proneness.

6) Improper tools and tackles:

For carrying out various maintenance activities different tools and tackles are needed by maintenance personnel. Management must provide adequate, suitable and good quality tools and tackles.

It is a penny wise, pound foolish policy to procure inferior quality tools and tackles and save some money. In the long range it will not only prove costly, but also can result in unsafe conditions of working.

7) Improper guards at moving parts:

In all textile machinery there are number of moving parts like rollers, shafts, pulleys, chains, wheels, belts etc. Many of these parts are such positioned where there is always danger of an accident taking place. Protecting guards are needed to provide at all such places to minimize chances of accidents. Improper or missing guards only enhance the risk factor.

From the above discussion it will be clear that management is mainly responsible for unsafe conditions where as mainly employees are responsible for unsafe acts. It has been proved by

mainly industry wide surveys that for unsafe acts contribute to almost 80% of the reported accidents and remaining 20% accidents are caused by Unsafe conditions. It is also experienced by many that about 75% of the accidents can be avoided by creating awareness about unsafe acts and unsafe conditions and providing necessary training to all the employees.

Wherever possible management should make efforts to avoid unsafe conditions. But in some cases it will not be possible to so because of the process requirements. Under such conditions extra precautions should be taken to train the concerned employees not to indulge in any unsafe acts.

SCOPE OF REDUCING ACCIDENTS IN TEXTILE INDUSTRY:

Scope for reduction in accidents in our textile industry can be assessed through comparison between different industries and within textile industry. The findings of surveys conducted in this direction are alarming for all of us.

1) The reported accidents are 3 to 4 times higher in textile industry as compared to other industries for same number of employees.
2) Cases of permanent disablement are about 6 times higher than engineering industries.
3) Wide variation in number of accidents exists between different textile units. Lowest reported figure is15 accidents/1000 workers/year and the highest figure is 300 accidents/1000 workers/year. The ratio is as high as 20:1.

One can easily understand the vast scope available for reducing accidents in our textile industry. This is a challenge for all of us and it can be met only through a well designed accident prevention scheme implemented to the best of our capacities.

ACCIDENT PREVENTION SCHEME:

Accident prevention scheme should be designed considering local conditions in unit. The features of the scheme will vary according to the size of the unit, nature of activities carried out, number of employees engaged etc. The scheme for a spinning mill will have to be different from the scheme for a composite mill. However, the basic principles will remain the same. The same are discussed here.

1) Participation from all:

Accidents affect everybody from the chairman to the doorman. The one who gets involved in an accident has to suffer irrespective of his position and status in the organization. As such everybody must participate in the accident prevention scheme. The participation should be by own will and not by force. The main responsibility lies with top management. Top level managers should set examples for others by their own involvement in safety measures. Safety scheme should be regarded as platform where employer and employees can come nearer to fight the war against accidents.

2) Creating awareness:

It is said that strength of the chain is the strength of its weakest link. Once the weak link gives way chain gets broken. Higher strength of the other links becomes useless.

Same logic holds well in case of safety and accidents. The entire chain from top to bottom is required to be strong in understanding safety measures and in their commitment to accident prevention scheme. Any weak link in this chain will harm the overall purpose of the scheme.

To avoid such happening management must take constant efforts to create and sustain safety awareness among the employees. The following steps can be taken in this direction.

a) Training and retraining of safety. This should be a continuous affair. If needed help from outside agencies and experts should be taken.

b) Regular programs should be arranged on safety. The programs should include lectures, group meetings and discussions, debates, poster competition, audio-video shows etc. Through all these programs one point must be emphasized again and again. That point is-'there is no holiday for safety'.

c) Accident prone processes and machines should be distinctly highlighted through suitable boards, posters, slogans etc in local language. Slogans and posters are very powerful tools of communication. Message can be conveyed in a most effective way through apt slogans and posters. Management should make use of these communication aids at the place of unsafe processes and machines.

3) Proper interlocking:

Many accidents take place when hands get gripped by revolving rollers or are torn by sharp revolving surfaces. Such accidents can be avoided by providing proper interlocking arrangement. Opening of doors/covers should be made impossible when the pars are revolving.

4) Use of protective equipment:

Different types of protective equipments are available for various activities. Management should first provide such equipment to the concerned staff members and then enforce its use.

5) Avoiding loose clothing:

Use of loose clothing should be totally avoided at the working place. This step will help in minimizing accidents.

6) Regular checkups:

There must be regular system of checking condition of tools, tackles, safety devices, scaffolding, stools, ladders, stair-cases etc. This work should be entrusted to some responsible officer. Though this appears insignificant in actual practice it has large influence on number of accidents.

7) First aid activities:

Training in first aid activities should be given to as many persons as possible. In every shift trained persons must be available in case of emergency.

8) Safety committee:

Safety committee can play a major role in minimizing accidents in any organization. For this purpose there is need to make it more effective through the following steps:

a) Committee meetings should be held at frequent intervals- Say once in a month.

b) Committee members should be from different disciplines-production, maintenance, personnel, administration etc. Worker's representatives should also be there.

c) Every reported accident should be discussed thoroughly in the committee meeting. If required the members should visit the place of the accident. The idea should be to analyze the factors responsible for the accidents, draw proper conclusions, prepare action plan for prevention and then implement it.

d) Continuous monitoring of the accident rate by the safety committee is a must. As other parameters like productivity, quality profitability etc are critically monitored in the organization accident rate and losses should also be critically monitored.

SUMMING UP:

Accidents very critically affect the work life in any organization. Employee's morale gets down if the accidents occur quite frequently. As such every organization should make all efforts to avoid accidents.

Very few accidents are real accidents. Majority of them are invited through unsafe acts as conditions. By controlling unsafe acts and conditions it is possible to drastically reduce the frequency of accidents and the subsequent losses. What is needed is a well designed accident prevention plan and its implementation in true spirit.