# APPAREL QUALITY STANDARD AND IMPLEMENTATION

## M.Sc COSTUME DESIGN AND FASHION

**School of Distance Education**
**Bharathiar University, Coimbatore - 641046**

Author: Dr. S. Kavitha


For
School Of Distance Education
Bharathiar University, Coimbatore - 641046

# CONTENTS

**UNIT I** **1**

1.1 Introduction to Quality Standards

1.2 Importance of Quality Standards

1.3 Benefits of Quality Standards

1.4 Levels and Sources of Quality Standards

1.4.1 Levels of Quality Standards

1.4.2 Sources of Quality Standards

1.4.2.1 American Society for Testing and Materials (ASTM)

1.4.2.2 American Association Textile Chemists and Colourists (AATCC)

1.5 British Standards & ISO Standards for the Apparel Industry

1.5.1 British Standards

1.5.2 ISO Standards

1.5.2.1 ISO 9000

1.5.2.2 14000 Standards

1.6 Total Quality Management Systems

1.7 Co Labeling & Oko Tex 100 Standards

1.7.1 Co Labeling

1.7.2 Oko Tex 100 Standards

1.8 Let Us Sum Up

1.9 Lesson End Activities

1.10 References

**UNIT- II** **23**

2.1 Introduction

2.2 Sensitizing Dye Stuffs

2.3 Allergic Dyes

2.4 Carcinogenic Amines

2.5 Dyes Red-Listed As Per Eco Specifications

2.6 Eco Management of Textile and Apparel Industry

2.7 Global Scenario

2.8 Eco Mark &Environment Friendly Textiles

2.9 Garment Defects
2.9.1 Cutting Defects
2.9.2 Sewing Defects
2.9.3 Assembly Defects
2.9.4 Pressing
2.9.5 Finishing and Packaging Defects
2.10 Let Us Sum Up
2.11 Lesson End Activities
2.12 References

**UNIT- III** **56**

3.1 Eco Specification & Restrictions In Apparels And Textiles
3.2 Dry Cleaning Using Ozone
3.3 Depleting Chemicals
3.4 ph Values
3.5 Formaldehyde Contents
3.6 Heavy Metal Contents
3.7 Pesticides and Herbicides
3.8 Azo Dye Stuffs
3.9 Nickel
3.10 Pentachlorol Phenols
3.11 Colour Fastness
3.12 Brighteners
3.13 Softening Agents
3.14 Let Us Sum Up
3.15 Lesson End Activities
3.16 Reference

**UNIT-IV** **82**

4.1 Introduction
4.2 Starting a Quality Control Program
4.3 Implementation of Quality Systems in Production Line
4.4 Product Specifications and Analysis Using Analytical Tools

4.5 Quality Management through Inspection
4.6 Testing And Seven Quality Tools
4.7 Let Us Sum Up
4.8 Lesson End Activities
4.9 References

**UNIT- V** **103**

5.1 Introduction
5.2 Quality Costs and Customer Returns
5.3 Inspection Procedures
5.4 AQL and Quality Control
5.5 Let Us Sum Up
5.6 Lesson End Activities
5.7 References

## UNIT- I

### OBJECTIVES

This unit will help you to under stand –

- The meaning and importance of quality standards
- Levels And Sources Of Quality Standards
- British Standards, ISO Standards, Co Labeling and OKO tex100 standards which give an idea about apparel quality standards.

### STRUCTURE

1.1 Introduction to Quality Standards
1.2 Importance of Quality Standards
1.3 Benefits of Quality Standards
1.4 Levels and Sources of Quality Standards
1.4.1 Levels of Quality Standards
1.4.2 Sources of Quality Standards
1.4.2.1 American Society for Testing and Materials (ASTM)
1.4.2.2 American Association Textile Chemists and Colourists (AATCC)
1.5 British Standards & ISO Standards for the Apparel Industry
1.5.1 British Standards
1.5.2 ISO Standards
1.5.2.1 ISO 9000
1.5.2.214000 Standards
1.6 Total Quality Management Systems
1.7 Co Labeling & Oko Tex 100 Standards
1.7.1 Co Labeling
1.7.2 Oko Tex 100 Standards
1.8 Let Us Sum Up
1.9 Lesson End Activities
1.10 References

## 1.1 INTRODUCTION TO QUALITY STANDARDS

Quality means customer needs is to be satisfied. Find out what the potential customer for a new product really wants, through the processes of design, specification, controlled manufacture and sale. Failure to maintain an adequate quality standard can therefore be unsuccessful. There are a number of factors on which quality fitness of garment industry is based such as - performance, reliability, durability, visual and perceived quality of the garment. Quality needs to be defined in terms of a particular framework of cost.

The term standard or standards in reference to quality control is defined as something that is established by authority, custom or general consent as a model or example to be followed. According to ISO, standards are documented agreements containing technical specifications or others precise criteria to be used consistently as rules, guidelines or characteristics, to ensure that materials, products, process and services are fit for their purpose. Standards are the result of a consensus and are approved by a recognized body. Standards aim at achieving the optimum degree of order in a given context. The process of formulating, issuing and implementing standards is called standardization.

A Quality standard is a documented process intended to control work resulting in a certain level of excellence (quality). The standard's degree of control is a basis for its selection for achieving that level of quality.

The primary aims of standards and standardization are

***Fitness for purpose*** the ability of the process, product or service to fulfill a defined purpose under specific conditions,

***Interchangeability*** through a deliberate standardization process, it is possible to make processes, products or services interchangeable, even if they are created in different countries.

***Variety reduction*** is for the selection, inter alia, of the optimum number of sizes, ratings, grades, compositions and practices to meet prevailing needs. Balancing between too many and too few varieties is in the best interest of both manufacturers and consumers

***Compatibility*** is the suitability of processes, products or services to be used together under specific conditions to fulfill the relevant requirements, without causing unnecessary interaction

***Guarding against factors that affect the health and safety of*** *consumers* the use of the process, product or service may pose a threat to human life or property. Therefore, identification of processes, products or services and their safety parameters, not only under normal use but under possible misuse, is one of the important requirements of standardization.

***Environmental protection*** The focus here is on preserving nature from damage that may be caused during the manufacture of a product or during its use or disposal after use. For example, the domestic use of a washing machine should generate only a minimum of pollutants.

***Better utilization of resources*** Achievement of maximum overall economy through *better utilization of resources* such as capital, human effort and materials is important.

***Better communication and understanding*** Whenever the transfer of goods and services is involved, standards spell out what means of communication are to be used between different parties. In public places such as airports, railway stations and highways for instance, standardized signs play an important role.

***Transfer of technology*** Standards act as a good vehicle for technology transfer. Since standards incorporate the results of advances in science, technology and experience, they reflect the state of the art in technical development.

***Removal of trade barriers*** Restrictions on the export of processes, products or services by the introduction of some technical barriers to trade, such as arbitrary product requirements, are being viewed with great concern. *Standards prevent such non-tariff barriers to trade* by harmonizing requirements in a manner that promotes fair competition. Purchasers can be convinced about the quality level of a product that has been manufactured according to a recognized standard.

## 1.2 IMPORTANCE OF STANDARDS

Standards make life safer, healthier and easier for people, organizations and enterprises all over the world. They enable communication and trade, while allowing resources to be used more efficiently. All businesses can benefit from standards: from global heavyweights to small local firms; from ambitious start-ups to long established household names, from hospitality, catering and retail businesses through construction, manufacturing and engineering firms to high tech innovators.

Businesses can use established standards to reduce time, effort and money they have to invest in the research and development of new products, while increasing their likelihood of success in the market place.

By providing best – practice guidance, standards help businesses to assess their processes, allowing them to take steps to increase efficiency and become more profitable. Standards also provide a reliable benchmark against which performance can be judged, enabling businesses to demonstrate product performance. Introducing standards can help businesses to retain existing clients and generate sales from new customers.

## 1.3 BENEFITS OF STANDARDS

Standards provide benefits to different sectors of society. Some of the benefits of standards are as follows:

**For manufacturers, standards:**

- ✓ Rationalize the manufacturing process.
- ✓ Eliminate or reduce wasteful material or labor.
- ✓ Reduce inventories of both raw material and finished products.
- ✓ Reduce the cost of manufacture.

**For customers, standards:**

- ✓ Assure the quality of goods purchased and services received.
- ✓ Provide better value for money.
- ✓ Are convenient for settling the disputes with suppliers

**For traders, standards:**

- ✓ Provide a workable basis for acceptance or rejection of goods or consequential disputes.
- ✓ Minimize delays, correspondence, etc., resulting from inaccurate or incomplete specification of materials or products.

**For technologists, standards:**

Provide starting points for research and development for further improvement of goods and services.

## 1.4 LEVELS AND SOURCES OF QUALITY STANDARDS

### 1.4.1 LEVELS OF QUALITY STANDARDS

There are various levels of standards. They are

**Company standards** - These standards are useful to the company's design, development, production, purchasing and quality control departments .It may be those developed by the company itself or developed by some other organization (s) and adopted by the company as its own standards.

**Industry standards** - These standards are typically developed by a trade association or professional society. For example American chemical society has for many years maintained specifications for chemical regents.

**Government standards** - These are standards either developed by the government or developed by some other organization (s) and adopt by the government. The government standards generally tend to be related to safety or well- being of the people.

**Full consensus standards** - These are standards developed by the representatives of all sectors, such as industry, consumer, government, academia, who have an interest in use of these standards either as a producer or consumer.

### 1.4.2 SOURCES OF QUALITY STANDARDS

Various standards developing organization such as American society for testing and materials (ASTM), American Association of textile chemists and colourists (AATCC), American national standards institution (ANSI), British standards institute (BSI), International standards organization (ISO), etc. are the largest sources of standards.

#### 1.4.2.1 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

Organized in 1898 ,ASTM Has grown into one of the largest voluntary standards development systems in the world .ASTM is a not – for -profit organization that provided a forum for producers, users ultimate consumers and those having a general interest (representatives of government and academia to meet on common ground and write standards for materials, products systems and services from the work of 132 standards writing committees, ASTM publishes standards test methods, specifications, guides, classifications and terminology. ASTM standard development activates encompass metals, paints, plastics, textile, petroleum, construction, energy, the environment, consumer products, medical services and devices, computerized systems, electronics and many other areas.

ASTM headquarters has no technical research or testing facilities such work is done voluntarily by 35,000 technically qualified ASTM members located throughout the world. More than 9,100 ASTM standards are published each year in the 71 volume Annual book of ASTM standards .Therese standards and related information is sold throughout the world. Of particular interest to the quality practitioners in the textile and apparel industry would be volumes 07.01 and 07.02 on textiles.

### 14.4.2.2 AMERICAN ASSOCIATION TEXTILE CHEMISTS AND COLOURISTS (AATCC)

Founded in 1921, the American Association of textile chemists and colourists has grown from a group of 270 charter members into world largest textile chemistry membership society with close to 7,000 members in the US and 60 countries. AATCC is a source of test methods in areas of colourfastness, wet processing fibre identification, and textile chemistry AATXX S TECHNICAL Manual published every year.

### 14.4.2.3 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

The ANSI has served in its capacity as administrator and coordinator of the united states private sector voluntary standardization system for 78 years in 1918 by five engineering societies and three government agencies the institute remains a private non-profits membership organization supported by a diverse constituency of private and public sector organizations.

The institute represents the interest of its nearly 1,400 company organization, government agency institutional and international members.

ANSI does not itself develop American National Standards (ANSs) rather it facilitates development by establishing consensus among qualified groups. The Institute ensures that its guiding principles, consensus, due process and openness are followed by more than 175 distinct entities currently accredited under one of

the Federation's three methods of accreditation (organization, committee or canvass). In 1995 alone the number of American National Standards increased by 10% to a new total of 11,500 approved ANS.

ANSI was a founding member of the ISO and plays an active role in its governance. ANSI is one of five permanent members to the governing ISO council and one of four permanent members of ISO's Technical Management Board. U.S participation, through the U.S National Committee, is equally strong in IEC. The USNC is one of the 12 members on the IEC's governing Committee of Action.

Through, ANSI, the United States has immediate access to the ISO and IEC standards development processes. ANSI participates in almost the entire technical program of both the ISO (78% of all ISO technical committees) and the IEC (91% of all IEC technical committees) and administers many key committees. As a part of its responsibilities as the U.S member body to the ISO and the IEC, ANSI accredits U.S. Technical Advisory Groups (U.S.TAGs) or USNC Technical Advisors (TAS) . The U.S.TAGs (or TA's) primary purpose is to develop and transmit, via ANSI, U.S. positions on activities and ballots of the international technical committee. In many instances, U.S standards are taken forward, through ANSI or its USNC, to the ISO or IEC where they are adopted in whole or in part as international standards. Since the work of international technical committees is carried out by volunteers from industry and government, not ANSI staffs, the success of these efforts often is dependent upon the willingness of U.S. industry and the U.S. government to commit the resources to ensure strong U.S. technical participation in the international standards process.

## 1.5 BRITISH STANDARDS & ISO STANDARDS FOR THE APPAREL INDUSTRY

### 1.5.1 BRITISH STANDARDS INSTITUTION (BSI)

British Standards institute is the National Standards Body of the UK, responsible for facilitating, drafting, publishing and marketing British Standards

and other guidelines. British Standards provides UK industry and other stakeholders with their major access to and influence on standardization, both in the European arena (with CEN, CENELEC and ETSI) and internationally (with ISO and IEC). It was founded in 1901and was incorporated by Royal Charter in 1929. A non-profit distributing organization, BSI remains independent of government, industry or trade associations.

### 1.5.2 ISO STANDARDS

The International Organization for Standardization widely known as ISO is an international standard-setting body composed of representatives from various nationalstandards organizations. Founded on February 23, 1947, the organization promulgates worldwide proprietary, industrial, and commercialstandards. It has its headquarters inGeneva, Switzerland

The organization today known as ISO began in 1926 as the International Federation of the National Standardizing Associations (ISA), whose focus was mainlymechanical engineering. It was disbanded in 1942 during World War II but was reorganized under its current name, ISO, in 1946, in London and the new organization officially began operations in February 1947.

ISO is a voluntary organization whose members are recognized authorities on standards, each one representing one country. The bulk of the work of ISO is done by the 2,700 technical committees, subcommittees, and working groups. Each committee and subcommittee is headed by a Secretariat from one of the member organizations.

The three official languages of the ISO areEnglish, French, and Russian. The organizations logos in two of its official languages, English and French, include the word ISO, and it is usually referred to by this short-form name.

**Benefits of ISO International Standards**

ISO International Standards ensure that products and services are safe, reliable and of good quality. For business, they are strategic tools that reduce costs by minimizing waste and errors and increasing productivity. They help companies to access new markets, level the playing field for developing countries and facilitate free and fair global trade.

### 1.5.2.1 ISO 9000 STANDARDS

The ISO 9000 family of standards is related to quality management systems and designed to help organizations ensure that they meet the needs of customers and other stakeholders while meeting statutory and regulatory requirements related to the product. The standards are published by ISO, the International Organization for Standardization, and available through National standards bodies. ISO 9000 deals with the fundamentals of quality management systems, including the eight management principles on which the family of standards is based. ISO 9001 deals with the requirements that organizations wishing to meet the standard have to fulfil.

**History**

ISO 9000 was first published in 1987. It was based on the BS 5750 series of standards from BSI that were proposed to ISO in 1979. However, its history can be traced back some twenty years before that, to the publication of the United States Department of Defence MIL-Q-9858 standard in 1959. MIL-Q-9858 was revised into the NATO AQAP series of standards in 1969, which in turn were revised into the BS 5179 series of guidance standards published in 1974, and finally revised into the BS 5750 series of requirements standards in 1979 before being submitted to ISO.

ISO 9000: had the same structure as the UK Standard BS 5750, with three 'models' for quality management systems, the selection of which was based on the scope of activities of the organization:

ISO 9001: Model for quality assurance in design, development, production, installation, and servicing was for companies and organizations whose activities included the creation of new products.

ISO 9002: Model for quality assurance in production, installation, and servicing had basically the same material as ISO 9001 but without covering the creation of new products.

ISO 9003: Model for quality assurance in final inspection and test covered only the final inspection of finished product, with no concern for how the product was produced.

ISO 9000:1987 was also influenced by existing U.S. and other Defence Standards ("MIL SPECS"), and so was well-suited to manufacturing. The emphasis tended to be placed on conformance with procedures rather than the overall process of management, which was likely the actual intent.

**Who is using them?**

Corporations around the world have been building and continue to build their quality systems around these standards. Both large and small companies with international businesses perceive the ISO 9000 series as a route to open markets and improved competitiveness. One doesn't have to be a multinational corporation to benefit from implementing these standards.

**What does being registered to ISO 9001, 9002, or 9003 mean?**

It means having an accredited independent third party conduct, an on-site audit of your company's operations against the requirements of the appropriate

standard. Upon successful completion of this audit, your company will receive a registration certificate that identifies your quality system as being in compliance with ISO 9001, 9002 or 9003. Your company will also be listed in a register maintained by the accredited third-party registration organization (called registrar). You may publicize your registration and use the third party registrar's certification mark on your advertising, letter heads, and other publicity materials, but not on your products.

**Advantages**

It is widely acknowledged that proper quality management improves business, often having a positive effect on investment, market share, sales growth, sales margins, competitive advantage, and avoidance of litigation. The quality principles in ISO 9000:2000 are also sound, according to Wade and also to Barnes, who says that "ISO 9000 guidelines provide a comprehensive model for quality management systems that can make any company competitive." Implementing ISO often gives the following advantages:

1. Creates a more efficient, effective operation
2. Increases customer satisfaction and retention
3. Reduces audits
4. Enhances marketing
5. Improves employee motivation, awareness, and morale
6. Promotes international trade
7. Increases profit
8. Reduces waste and increases productivity
9. Common tool for standardization.

### 1.5.2.2 ISO 14000 STANDARDS

ISO 14000 is similar to ISO 9000 quality management in that both pertain to the process of how a product is produced, rather than to the product itself. The

requirements of ISO 14000 are an integral part of the European Union's Eco-Management and Audit Scheme (EMAS). EMAS's structure and material requirements are more demanding, foremost concerning performance improvement, legal compliance and reporting duties.

The ISO 14000 family consists of standards relating to environmental management systems (EMS) and others which are tools to help the organization realize its environmental policy, objectives and targets, and classify them by application:

- ❖ At the organizational level (implementing EMS, conducting the environmental auditing and related investigations, and evaluating environmental performance).
- ❖ To Products and services (using environmental declarations and claims, conducting life cycle assessment), addressing environmental aspects in product standards, and understanding terms and definitions).

ISO 14000 is a family of standards related to environmental management that exists to help organizations

(a) Minimize how their operations (processes etc.) negatively affect the environment (i.e. cause adverse changes to air, water, or land);

b) Comply with applicable laws, regulations, and other environmentally oriented requirements, and

(c) Continually improve in the above.

**List of ISO 14000 series standards**

- ✓ ISO 14001 Environmental management systems—Requirements with guidance for use

- ✓ ISO 14004 Environmental management systems—General guidelines on principles, systems and support techniques
- ✓ ISO 14015 Environmental assessment of sites and organizations
- ✓ ISO 14020 series (14020 to 14025) Environmental labels and declarations
- ✓ ISO 14030 discusses post production environmental assessment
- ✓ ISO 14031 Environmental performance evaluation—Guidelines
- ✓ ISO 14040 series (14040 to 14049), Life Cycle Assessment, LCA, discusses pre-production planning and environment goal setting.
- ✓ ISO 14050 terms and definitions
- ✓ ISO 14062 discusses making improvements to environmental impact goals.
- ✓ ISO 14063 Environmental communication—Guidelines and examples
- ✓ ISO 14064 Measuring, quantifying, and reducing Greenhouse Gas emissions.

**Potential benefits**

- ✓ ISO 14000 covers a wide range of requirements that may go beyond compliance and legislation in seeking to improve the quality of the organization's environmental management activities.
- ✓ ISO 14000 is one of the most nationally and internationally known environmental standards that affirms the independent approval of a management system designed specifically to deliver high levels of customer satisfaction
- ✓ ISO 14000 can help organizations reduce waste, energy use and resources that can help to reduce costs.
- ✓ It has the potential to improve internal and external assurance and communication of management and environmental impacts.

**Potential limitations**

- ✓ Pursuing the Standard has the potential to be expensive in terms of start-up and running costs can be time consuming to implement
- ✓ There is less flexibility than other tools and it is much more difficult to use in smaller parts or for single issues.
- ✓ Although it is used in a variety of public and private sector organisations, there are few examples of other social enterprises that have used the Standard and therefore implementing and drawing upon other organisations' experiences and making comparisons may be difficult.
- ✓ Elements of the 'management standard' may pose difficulties in implementing within non-hierarchical organization's or non-traditional working structures such as co-operatives.

**Who can use ISO 14000 Series?**

ISO 14000 standards are implemented by thousands of organisations internationally. It is most widely used in the private and public sectors and by large organisations, but it can also be used by small and medium sized organizations and the social enterprise sector.

## 1.6 TOTAL QUALITY MANAGEMENT SYSTEMS

### 1.6.1 INTRODUCTION

TOTAL quality Management strives towards the achievement of quality in everything one does. Quality means conformance to customer requirements. In to-days highly competitive economy, business must face the challenge of continually improving the quality of the goods or services. TQM involves everyone in the organization. It aims at standardizing and improving all process in the organization. The function of quality has evolved from more product inspection to an all-encompassing TQM. It is no longer just a Technical function; it has become a management discipline.

## 1.6.2 OBJECTIVES OF TQM

Total Quality requires management practices to shift towards a new form. It includes the following components:

1. Customer needs, not production, are focus.
2. The system becomes more horizontal with everyone working towards a single goal, to serve the customer better.
3. Everyone is considered in decision-making.
4. Employee empowerment and responsibility replace rigid policies and procedures.
5. Cooperation across function is frequent.
6. Team takes on some of the roles of departments.
7. Workers are cross-trained and their jobs are more flexible.

## 1.6.3 TQM IN MANUFACTURING ORGANIZATION

In a manufacturing organization, TQM generally starts by sampling a random selection of the product. The sample is then tested for things that matter to the real customers. The causes of any failures are isolated, secondary measures of the production process are designed, and then the causes of the failure are corrected. The statistical distributions of important measurements are tracked. When parts' measures drift out of the error band, the process is fixed. The error band is usually tighter than the failure band. The production process is thereby fixed before failing parts can be produced.

## 1.6.4 TOTAL QUALITY MANAGEMENT MODEL

In order to develop a systematic approach to TQM planning and implementation, a good strategy is to take a book at companies which are recognized quality leaders in the field. Especially firms that have been awarded the

prestigious Malcoln Baldrige Quality Award, generally recognized as a superior achievement in the field of Total Quality.

**a. Leadership**

Quality values and customer orientation flow from senior managers. It's important that they commit themselves to quality and that they devise the systems and strategies for achieving it. It's especially important that senior managers be visible in their quality activities. They should be active in quality planning, and should take the lead in communication quality goals to the organization.

**b. Information and Analysis**

This is the brain centre of the quality improvement process TQM emphasizes management by fact. Reliable and timely data are the key ingredients in tracking quality and making improvements in process. To achieve total quality, your company must consider a wide range of information: customer, product and service performance operation, market dynamics competition, costs and supplier data.

**c. Strategic Quality Planning**

The idea of TQM is not for quality to become your company's sole focus. Rather, you must formulate your business plans in such a way that quality contributes to productivity and ultimately to financial improvement. Total quality cannot be added after you have determined long term or short term plans. The idea only makes sense when it is in corporate into evaluation of projection market conditions, competitive climate and financial situation.

**d. Human Resources development and Management**

The success of you TQM effort will ultimately depend on the utilization of Human resource. Your employees are the ones who will implement quality process, who will make sure quality levels are maintained, and who will contribute ideas for continuous improvement.

**e. Management of Process Quality**

TQM continually return to the idea of "process". This is because of the emphasis on designing it on. The answer to all quality problems ultimately lies in improving a process or system.

**f. Quality and Operational Results**

The analysis and improvement of process is an important emphasis of TQM, but only as a means to achieving results. You should never become so caught up in the planning or implementation of TQM that you lose sight of fact that it is a result-oriented approach.

**g. Customer Focus and Satisfaction**

This is the single most important factor in the Baldrige Award criteria. The reason is that customer focus is what drives all the other aspects of TQM. No company can achieve quality in a vacuum. It is the market place that should determine quality at every level.

## 1.7 ECO LABELING & OKO TEX 100 STANDARDS

### 1.7.1 ECO-LABELING OF TEXTILES

In order to promote the concept of eco-friendly textiles, a comprehensive system of eco labels is advocated by European and other Western countries. For the purpose of issuing eco labels, certain norms/criteria are stipulated in respect of textile products, on the basis of Cradle-to-Grave approach. i.e. these criteria are developed on analysing the product's entire life cycle commencing with extraction of raw materials, progressing through the stages of production, distribution and utilisation and disposal after use. The norms are also referred to as Eco Standards. By and large, these standards are voluntary in nature.

While formulating eco-norms for the issuance of eco labels, at present the use of 7 different classes of chemicals in textile production and processing are taken into consideration. These are:

- Formaldehyde
- Toxic pesticides
- Pentachlorophenol (PCP)
- Heavy metal traces
- Azo dyes which release carcinogenic amines
- Halogen carriers
- Chlorine Bleaching

The eco standards stipulated by (i) MST, the German Textile Association, (ii) OTN 100, the famous OEKOTEX Institute from Austria, (iii) Clean fashion and (iv) Steinmann, the two private eco-label issuing organisations in Germany are popular in European countries. In addition to the four eco labels specified above, a number of private and national labels are operating in Europe. In some cases these labels are used solely as a marketing instrument and have little factual and technical substance. In the face of the proliferation of eco labels, the Coordination Committee for the Textiles Industries in the EEC (COMITEXTIL) supports a single European label. Further, it is learnt that the European Union is finalizing the criteria for a common "European Community Eco label" (EC-Eco label) after taking into consideration the criteria specified by other eco labels.

The Government of India has also evolved eco standards for the eco labeling of the textile items in consultation with the Indian Textile Trade and Industry. The criteria for the environmentally friendly textiles including Cotton, Woollen, Man-made, Jute and Silk products was notified in the Gazette on October 8, 1996 by Ministry of Environment and Forests. The eco-labeling of textiles notified in the Gazette is a voluntary scheme. This scheme aims at distinguishing through the agency of Eco-Mark, any product which is made, used or disposed of

in a way that significantly reduces the adverse effect; it would otherwise have on the environment. The Earthen Pot is being used as the logo of this scheme.

A comparison of the norms/criteria stipulated for eco parameters in the popular eco labels operating in Europe and in the Indian Eco Mark Scheme for textiles are as under:

**TABLE: 1.1 ECOPARAMETERS FOR TEXTILES**

| S. No | Eco Parameter | Criteria/Norms stipulated in ppm | | | | | |
|---|---|---|---|---|---|---|---|
| | | M.S.T | OTN 100 | Clean Fashion | Steil-mann | COMIT-EXTIL | Indian Eco Label |
| | Formaldehyde<br>(i) Baby Clothing<br>(ii) Close to skin<br>(iii) Outer wear | <br>20<br>75<br>300 | <br>20<br>75<br>300 | <br>20<br>75<br>300 | <br>50<br>300<br>500 | <br>20<br>75<br>300 | <br>20<br>75<br>300 |
| | Toxic Pesticides | 1 | 5 | 1 | 1 | 0.1 to 1 | 1 |
| | Pentachlorophenol | 0.5 | -- | 0.5 | Ban | 0.05 to 0.5 | 0.5 |
| | Heavy Metals<br>(i) Arsenic<br>(ii) Lead<br>(iii) Cadmium<br>(iv) Mercury<br>(v) Copper<br>(vi) Chromium<br>(vii) Cobalt<br>(viii) Zinc<br>(ix) Nickel | 0.001 to 0.01<br>0.004 to 0.04<br>0.0005 to 0.005<br>0.0001 to 0.1<br>0.3 to 100.0<br>1 to 20<br>2 to 20<br>0.5 to 5.0<br>0.02 to 10.0 | | | | | 10.0 (for all heavy metals) |
| | Azo dyes containing carcinogenic amines | Ban | Ban | Ban | Ban | Ban | 50.0 |
| | Halogen Carriers | Ban | --- | --- | Ban | Ban | 200.0 |
| | Chlorine Bleaching | — | — | — | To avoid | Ban | — |

### 1.7.2 Oko-Tex Standard 100

Oeko-Tex Standard 100 or Oko-Tex Standard 100 (sometime misspelled Oktex) is an international testing and certification system for textiles, limiting the use of certain chemicals. It was developed in 1992.

Responsibility for the Oeko-Tex Standard 100 is shared between the 17 test institutes which make up the International Oeko-Tex Association, which has branch offices in more than 40 countries worldwide. The criteria catalogue which forms the basis for the tests for harmful substances is based on the latest scientific findings and is continually updated; the human ecological safety of the textiles tested are more far-reaching every year.

The test criteria and the related test methods are standardized on an international level and are widely included as guidance in terms and conditions of purchase and delivery right through to the retail sector. With a total of over 51,000 certificates issued for millions of different individual products, and over 6,500 companies involved worldwide, the Oeko-Tex Standard 100 has become the best known and most successful label for textiles tested for harmful substances.

The Oeko-Tex label is a recognized benchmark for the consumer and also serves as an additional quality assurance tool for the manufacturer. The concept has become established as a safety standard throughout the textile manufacturing chain and enables checks to be made for any harmful substances at each stage in the production process. The test samples are tested by the independent Oeko-Tex institutes for their pH-value, formaldehyde content, the presence of pesticides, extract-able heavy metals, chlorinated organic carriers and preservatives such as pentachlorophenol and tetrachlorophenol. The tests also include checks for any MAC amines in azo dyestuffs and allergy-inducing dyestuffs.

The use of flame retardant and biocidic finishes is also prohibited in the clothing sector. The certificates issued are distributed or allocated in line with the international guidelines and specifications of the Oeko-Tex Test Association.

**Check your progress 1**

Explain the systematic approach to TQM

**Notes:** Write your answer in the space given below

---

---

---

---

---

---

---

---

---

## 1.8 LET US SUM UP

Standards are documented agreements containing technical specifications or others precise criteria to be used consistently as rules, guidelines or characteristics, to ensure that materials, products, process and services are fit for their purpose. Quality standards for the apparel industry and its management systems help to improve all process in the organization. Quality standards provide confidence among the consumers that the products are tested against standards and must be good and free from toxic substances.

## 1.9 LESSON END ACTIVITIES

Analyse whether labelling provides confidence to the consumers that there will not be any health hazards in using the textile materials and apparels.

## 1.10 REFERENCES

1. Managing quality control in apparel industry, Pradeep V Mehta, NIFT Publications

## UNIT- II

### OBJECTIVES

This unit will help you to under stand

- about sensitizing and allergic Dye Stuffs and its usage as per Eco- standards
- various eco-problems in the textile industry
- Eco management of textile and apparel industry
- Garment Defects
- Eco Mark and Environment Friendly Textiles

### STRUCTURE

2.1 Introduction
2.2 Sensitizing Dye Stuffs
2.3 Allergic Dyes
2.4 Carcinogenic Amines
2.5 Dyes Red-Listed As Per Eco Specifications
2.6 Eco Management of Textile and Apparel Industry
2.7 Global Scenario
2.8 Eco Mark &Environment Friendly Textiles
2.9 Garment Defects
2.9.1 Cutting Defects
2.9.2 Sewing Defects
2.9.3 Assembly Defects
2.9.4 Pressing
2.9.5 Finishing and Packaging Defects
2.10 Let Us Sum Up
2.11 Lesson End Activities
2.12 References

## 2.1 INTRODUCTION

The textile industry is considered as the most ecologically harmful industry in the world. The eco-problems in textile industry occur during some production processes and are carried forward right to the finished product. In the production process like bleaching and then dyeing, the subsequent fabric makes a toxin that swells into our ecosystem. Therefore the need of eco textiles is felt.

## 2.2 SENSITIZING DYE STUFFS

Among textile dyes, disperse dyes are considered the most responsible. In particular, disperse blue dyes were recently selected as "contact allergens of the year 2000". Patch tests with disperse dyes performed on children with suspected ACD and/or atopic dermatitis have shown a positively of 4.6%. The most common sensitizer was Disperse Yellow 3. Both animal tests and human patch test studies have shown significant potential for sensitization to disperse blue 35, 106 and 124. The above dyes have been reported to cause an ACD to a variety of garments which include underwear, blouses, pants swimsuits etc., There is evidence that at least 15 disperse dyes are contact allergens particularly those applied to garments made of synthetic fiber and worn skin tight. In the 70s this phenomenon was called as 'stockings dye allergy' and in 90s as 'legging allergy'

### BASIC DYES

The Basic dyes also indicated as textile allergens are used to colour wool, other protein fibers and some manmade fibers (nylon). Acid Yellow 23, Supramine Yellow and Red and Acid Violet 17 belong to this class.

### DIRECT DYES

Direct dyes are directly applied on fibers, most often wool, cotton, flax and leather. Binding is not very strong, as a result the colour fastness is only moderate.

However these agents are characterized by a low absorption through the skin. Direct Black 38 has been reported to be an allergen.

**VAT DYES**

Vat dyes are relatively hypoallergenic. Vat green1 has been reported to cause five cases of contact dermatitis in blue uniforms of nurses.

**REACTIVE DYES**

These dyes are used for colouring natural fibres as cotton, silk and wool. Asthma and contact dermatitis have been described after occupational exposure to reactive dyes. A study conducted on 1813 subjects patch tested with 12 reactive dyes has revealed 18 patients sensitized to these dyes.

**AZO DYES**

Regulations for azo dyestuffs are actually for certain azo dyestuffs that produce amine classified as carcinogenic due to reduction decomposition. In the present context, specific azo dyes releasing any of the 20 harmful amines have been banned as per the German Legislation.

## 2.3 ALLERGIC DYES

Allergy-inducing dyestuffs are particularly relevant to textiles. Textile dyes, which can be divided into several types (i.e. disperse, reactive, acid and direct) are the main causes of textile contact dermatitis. There has been an increasing frequency of contact dermatitis to clothing, in part undoubtedly to the greater awareness of this condition. Although dyes in clothing may be allergenic, there is a difference between a patch test, where the dye is placed directly on the skin, and a dyed textile where the dye will not transfer as easily to the skin; however, excess dye on a fabric may be readily available to the skin.

As well as this, the prevalence of sensitization to dyes is quite high among the allergic population. A study in 2003indicated that 12.3% of those patch tested

were allergic to a dye and/or resin allergen; the highest incidence of sensitization from the dye group allergens was due to Disperse Blue 124, 106 and 85; these Disperse dyes have also been shown to induce purpuric contact dermatitis. Although the presence of allergenic or harmful dyes is of obvious relevance to clothing, it also has relevance to children's stuffed toys where the fabric may often be in direct contact with the skin. In the EU some steps have been taken towards testing for these types of dyes in toys, embodied in EN71-9, although at present this is a voluntary standard, unlike parts 1–3 of the same standard.

Any location where the clothing is held more tightly against the skin is a likely spot for textile dermatitis. Clothing dermatitis is generally attributed to chemicals and dyes added to these fibers during their manufacture and assembly into garments. Attention should be paid as some dyestuffs contain allergenic (sensitizing) properties. Parameters influencing the risk of sensitization in textile dyes include not only the allergenicity of dye molecule but also the fastness of the dye i.e., how well it is bound to the fabric and the percutaneous absorption. Frictions, overweight and sweating are considered determining factors on the distribution of the dermatitis. Few are

- Allergic contact dermatitis
- Occupational allergic contact dermatitis
- contact urticaria
- Purpuric allergic contact dermatitis
- Pigmented contact dermatitis
- Erythroderma
- Contact dermatitis presenting as lichen
- Phototoxic textile dermatitis
- Irritant contact dermatitis
- Folliculitis
- Atopic dermatitis

## 2.4 CARCINOGENIC AMINES

Due to their versatility, synthetic azo dyes have been used extensively since the mid-nineteenth century. However, it has been found that under reducing conditions, such as during application, these dyes produce amines, of which 20 are known carcinogens which are reported to be toxic or carcinogenic in nature. In response, Germany has banned the import, stock and sale of textiles and other materials which have prolonged contact with human skin, and which exceed the regulatory limits of the specified amines.

**Banned Carcinogenic Amines**

The following 4 amines are highly carcinogenic

- 4-Aminodiphenyl
- Benzidine
- 4-chlorotoluidine
- 2-Naphthylamine

The remaining 16 amines are also carcinogenic and having harmful effects on the human skin.

## 2.5 DYES RED-LISTED AS PER ECO SPECIFICATIONS

The Ministry of Environment and Forests, Government of India has prohibited the handling of benzidine based dyes vide the notification published in the Gazette in January, 1990. As per this notification, handling of all the 42 benzidine based dyes is prohibited from 1993 onwards. These are related to banned amines.

The Ministry of Environment and Forests has further prohibited the handling of 70 more azo dyes which came under the banned category as per the notification published in the Gazette on 26th March, 1997. Thus, the Ministry of Environment and Forests has prohibited the handling of 42+70=112 dyes which are capable of releasing any of the harmful amines.

## TABLE : 2.1 LIST OF 42 BENZIDINE BASED DYES PROHIBITED FROM 1993

| S.No. | CI Generic Name | CI Constn. No. |
|---|---|---|
| 1. | Acid Orange 45 | 22195 |
| 2. | Acid Red 85 | 22245 |
| 3. | Acid Black 29 | - |
| 4. | Acid Black 94 | 30336 |
| 5. | Azoic Diazo Compo.112 | 37225 |
| 6. | Direct Yellow 1 | 22250 |
| 7. | Direct Yellow 24 | 22010 |
| 8. | Direct Orange 1 | 22370 |
| 9. | Direct Orange 8 | 22130 |
| 10. | Direct Red 1 | 22310 |
| 11. | Direct Red 10 | 22145 |
| 12. | Direct Red 13 | 22153 |
| 13. | Direct Red 17 | 22150 |
| 14. | Direct Red 28 | 22120 |
| 15. | Direct Red 37 | 22240 |
| 16. | Direct Red 44 | 22500 |
| 17. | Direct Violet 1 | 22570 |
| 18. | Direct Violet 12 | 22550 |
| 19. | Direct Violet 22 | 22480 |
| 20. | Direct Blue 2 | 22590 |
| 21. | Direct Blue 6 | 22610 |
| 22 | Direct Green 1 | 30280 |
| 23. | Direct Green 6 | 30295 |
| 24. | Direct Green 8 | 30315 |
| 25. | Direct Green 8:1 | -- |
| 26. | Direct Brown 1 | 30045 |
| 27. | Direct Brown 1:2 | 30110 |
| 28. | Direct Brown 2 | 22311 |
| 29. | Direct Brown 6 | 30140 |
| 30. | Direct Brown 25 | 36030 |

| S.No. | CI Generic Name | CI Constn. No. |
|---|---|---|
| 31. | Direct Brown 27 | 31725 |
| 32. | Direct Brown 31 | 35660 |
| 33. | Direct Brown 33 | 35520 |
| 34. | Direct Brown 51 | 31710 |
| 35. | Direct Brown 59 | 22345 |
| 36. | Direct Brown 79 | 30056 |
| 37. | Direct Brown 95 | 30145 |
| 38. | Direct Brown 101 | 31740 |
| 39. | Direct Brown 154 | 30120 |
| 40. | Direct Black 4 | 30245 |
| 41. | Direct Black 29 | 22580 |
| 42. | Direct Black 38 | 30235 |

## TABLE: 2.2 LISTS OF 70 AZO DYES PROHIBITED FROM MARCH 1997

| S.No. | CI Generic Name | CI Constn. No. |
|---|---|---|
| 1 | Acid Red 4 | 14710 |
| 2 | Acid Red 5 | 14905 |
| 3 | Acid Red 24 | 16140 |
| 4 | Acid Red 26 | 16150 |
| 5 | Acid Red 73 | 27290 |
| 6 | Acid Red 114 | 23635 |
| 7 | Acid Red 115 | 27200 |
| 8 | Acid Red 116 | 26660 |
| 9 | Acid Red 128 | 24125 |
| 10 | Acid Red 148 | 26665 |
| 11 | Acid Red 150 | 27190 |
| 12 | Acid Red 158 | 20530 |
| 13 | Acid Red 167 | -- |

| S.No. | CI Generic Name | CI Constn. No. |
|---|---|---|
| 14 | Acid Red 264 | 18133 |
| 15 | Acid Red 265 | 18129 |
| 16 | Acid Red 420 | -- |
| 17 | Acid Voilet 12 | 18075 |
| 18 | Acid Brown 415 | -- |
| 19 | Acid Black 131 | -- |
| 20 | Acid Black 132 | -- |
| 21 | Acid Black 209 | -- |
| 22 | Basic Red 111 | -- |
| 23 | Basic Red 42 | -- |
| 24 | Basic Brown 4 | 21010 |
| 25 | Developer 14 = Oxidation Base 20 | 76035 |
| 26 | Direct Yellow 48 | 23660 |
| 27 | Direct Orange 6 | 23375 |
| 28 | Direct Orange 7 | 23380 |
| 29 | Direct Orange 10 | 23370 |
| 30 | Direct Orange 108 | 29173 |
| 31 | Direct Red 2 | 23500 |
| 32 | Direct Red 7 | 24100 |
| 33 | Direct Red 21 | 23560 |
| 34 | Direct Red 22 | 23565 |
| 35 | Direct Red 24 | 29185 |
| 36 | Direct Red 26 | 29190 |
| 37 | Direct Red 39 | 23630 |
| 38 | Direct Red 46 | 23050 |
| 39 | Direct Red 62 | 29175 |
| 40 | Direct Red 67 | 23505 |
| 41 | Direct Red 72 | 29200 |
| 42 | Direct Violet 21 | 23520 |

| S.No. | CI Generic Name | CI Constn. No. |
|---|---|---|
| 43 | Direct Blue 1 | 24410 |
| 44 | Direct Blue 3 | 23705 |
| 45 | Direct Blue 8 | 24140 |
| 46 | Direct Blue 9 | 24155 |
| 47 | Direct Blue 10 | 24340 |
| 48 | Direct Blue 14 | 23850 |
| 49 | Direct Blue 15 | 24400 |
| 50 | Direct Blue 22 | 24280 |
| 51 | Direct Blue 25 | 23790 |
| 52 | Direct Blue 35 | 24145 |
| 53 | Direct Blue 53 | 23860 |
| 54 | Direct Blue 76 | 24411 |
| 55 | Direct Blue 151 | 24175 |
| 56 | Direct Blue 160 | -- |
| 57 | Direct Blue 173 | -- |
| 58 | Direct Blue 192 | -- |
| 59 | Direct Blue 201 | -- |
| 60 | Direct Blue 215 | 24115 |
| 61 | Direct Blue 295 | 23820 |
| 62 | Direct Green 85 | 30387 |
| 63 | Direct Blue 222 | 30368 |
| 64 | Direct Black 91 | 30400 |
| 65 | Direct Black 154 | -- |
| 66 | Disperse Yellow 7 | 26090 |
| 67 | Disperse Yellow 23 | 26070 |
| 68 | Disperse Yellow 56 | -- |
| 69 | Disperse Orange 149 | -- |
| 70 | Disperse Red 151 | 26130 |

## 2.6 ECO MANAGEMENT OF TEXTILE AND APPAREL INDUSTRY

An effective ecology management system involves establishing a complete organizational structure that embraces every aspect of the industry- procurement of raw materials, to working process, to the finished product. The company must develop a formal system, appropriately recorded and implemented.

### STEPS INVOLVED IN ECO MANAGEMENT SYSTEM

- Preparing an Ecology Policy Statement
- Defining responsibility and authority
- Nominating a Management Representative
- Reviewing orders systematically
- Purchase Policy
- Assessing Suppliers
- Identifying and tracing materials, components. Processes, products and personnel.
- Preparing specifications for Raw Materials & Accessories
- A verification system for incoming materials & accessories.
- Testing, calibration and checking procedures
- Compiling meaningful records
- Establishing HRD training and records
- Independent Eco – Auditing.

### Preparing an Ecology Policy Statement

The ecological policy involves 2 features:

1. The objective of the business
2. Its dedication to achieving the objectives

The policy statement must be accepted at all levels in the organization

**Defining Responsibility & Authority**

Preparation of an organizational chart and a set of job descriptions

Job Descriptions:

- ✓ Job title of the person concerned
- ✓ Purpose of the appointment
- ✓ To whom the person is responsible
- ✓ The authority invested in the person
- ✓ Duties and responsibilities of the person

**Nominating a Management Representative**

A management representative should be nominated persons of senior status. He should ensure that eco-organization is implemented and maintained in accordance with the documented system.

**Reviewing Orders Systematically**

Innovative manufacturers try to 'by-pass' suppliers with low eco standard. They adopt innovative strategy to select new innovative suppliers using safety data sheets, supplier oriented eco labels and new eco standards fixed in purchase contracts.

**Assessing Suppliers**

A record of approved suppliers must be maintained. It is rated with regard to the ecology of its products or services, its willingness to co-operate in emergency, its conformance with required delivery dates and clarity of documentation and an approved list of suppliers must be reviewed at prescribed intervals.

## Identifying and Tracing Materials, Components, Processes, Products and Personnel

Each incoming consignment is allocated a batch number and recorded in a goods received book. When the item is put to work the batch number can be recorded on the works order. It will be easy to trace the materials used, provided the works order has been retained on file.

## Preparing Specifications for Raw Materials & Accessories

In purchasing, the objective is to buy the best quality consistent with price. A complete product specification of raw materials and accessories has to be maintained. For example, details of the supplier, type, colour and substances used etc.

## A Verification System for Incoming Materials & Accessories

Testing methods

- 100% inspection
- Random inspection testing
- Calibration and checking procedures

Testing should be carried out systematically, results recorded and retained for future reference. The serviceability and accuracy of test equipment's must be checked periodically and calibrated. The dates of last and next calibration must be affixed to the instrument.

## Compiling Meaningful Records

Compiling records is time consuming and is often regarded as nuisance. But properly compiled and preserved records are used to determine long term trends. Records should be controlled by a specified person responsible for compiling.

**Establishing HRD Training and Records**

Eco related training, motivation and change of organization structure is necessary. Managers responsible for implementation of eco relevant activities must be appointed. Refresher course must be conducted regarding latest developments, emergence of new standards and evolution of new process technology.

**Independent Eco – Auditing**

The Eco Management system requires a review from time to time. All aspects of the system must be audited at predetermined intervals. The audit must cover every part of the organization including purchasing, training, management, responsible and document control. It is important to determine the timing and frequency of the eco audit plan. The records should be retained on file for future reference.

## 2.7 GLOBAL SCENARIO

Ecological considerations are becoming important factors in the marketing of consumer goods including textiles all over the world. Textile exporters must therefore be in a position to adopt their products and processing techniques to comply with new environmental regulations. There will be no season's specific textile and apparels, external factors will rapidly change scenarios, customization & the web will be more prominent

Environmental pollution and global warming will have to be considered while producing textile materials. The world already has imposed strict rules and regulations regarding this. Multi seasonal apparels will gain prominence. External factors like exchange rates of the currencies such as Dollar, Euro, Yuan, Rupee etc., the fall and rise of petrol prices, air transport, country specific and global political situations will have greater impact on the rise or slowdown of the industry. Internet sales are growing significantly and it will grow further.

Apparel trade in post quota regime has transformed the business world to a global village. The old concept derived from four P(s)-product, price, place and promotion has been replaced with a new pattern, the four C(s)-consumer, cost, convenience and communication. Undoubtedly, there is more competition on a level playing field since dependence on quota- profile is no more be an advantage of any country. To survive in this network, there is a paradigm shift toward attitude in working-out strategies in the garment arena. Assurance of international standards, product innovation and adaptability to changing tastes of consumer are some of the areas current interest.

## 2.8 ECO MARK & ENVIRONMENT FRIENDLY TEXTILES

### 2.8.1 ECO MARK

**Ecomark** or **Eco mark** is a certification mark issued by the Bureau of Indian Standards (the national standards organization of India) to products conforming to a set of standards aimed at the least impact on the ecosystem. The marking scheme was started in 1991. One of the purposes of the mark is increasing awareness among the consumers towards reducing environment impact. The mark is issued to various product categories and the development of standards for more products is in progress.

### 2.8.2 ENVIRONMENT FRIENDLY TEXTILES

In recent years ecological issues have loomed large especially in textile and apparel industry, an industry not noted for eco friendliness. Every textile item releases effluents that are harmful to the environment. The traditional textile industry consumes large amounts of earth's natural resources and pollutes the environment as their production and processing involves Chemical Intensive Applications therefore the need for green textiles.

During the production process controlling pollution is as vital as making a product free from the toxic effect. The utilization of rayon for clothing has added

to the fast depleting forests and opened the door to the development in natural sustainable fibres like organic Cotton, Hemp and Bamboo fibres. Petroleum-based products are harmful to the environment. In order to safeguard our environment from these effects, an integrated pollution control approach is needed. Fabrics made in eco-friendly way can substitute normal products. Green textiles refer to clothing and other accessories that are designed to use organic and recycled materials, less packaging and more energy-efficient manufacturing. Reducing the environmental impact throughout the life-cycle of a fabric item or using lower impact products can contribute actively to improve the situation. In general, there are four major environmental key factors associated with the making of textiles: water, energy, pollution, and use of non-renewable resources.

**Green Activities in Textile Industries**

Textile and clothing manufacturers are encouraged to re-examine the whole life cycle of their products with the aim to minimize environmental degradation at every stage, from manufacturing to disposal. They have to pay special attention in the selection of dyes and ensure the products are low in formaldehyde and free from pesticides and heavy metals.

**Check your progress 1**

When moving to an environmentally-friendly lifestyle, how could the textile and clothing industry minimize environmental degradation at every stage, from manufacturing to disposal?

---

---

---

---

---

---

**Check your progress 2**

Did you know that what % of insecticides is used globally for growing cotton?

**Model answers to check your progress**

Globally 22.5 percent of all the insecticides are used for growing cotton. Growing enough cotton for one t-shirt requires 257 gallons of water. On top of that, bleaching and then dyeing the resulting fabric creates toxins that flow into our ecosystem.

## 2.9 GARMENT DEFECTS

**Defect Definition and Classification**

Defects are categorized as major or minor depending on the severity. To determine whether a defect is major or minor, the following will be considered.

**Major Fault**

Major faults are faults that are outside tolerance and specification equal to or more than a grade. This is a defect which is sufficient to cause the garment to be considered as second's quality.

- A defect which is obvious
- Affects the salability or serviceability which worsens with wear and time
- Varies significantly from the approval garment specification

**Minor Fault**

Minor faults are faults that are outside tolerance and specification less than a grade. This is a defect which would not normally be identified by the customer, but is, however less than the agreed quality standard. A defect which

- ❖ Does not affect the performance of the garments in normal conditions

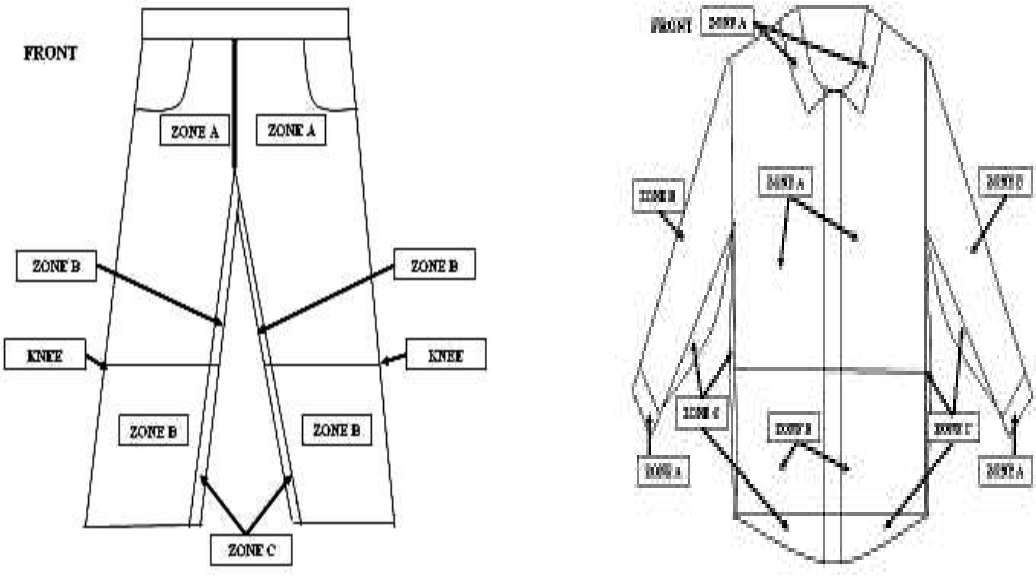
- ❖ Is not noticeable to the customer on purchasing
- ❖ Is not noticeable to the wearer of the garment, or anyone adjacent to the wearer
- ❖ Will not worsen with time and wear

**Defect Zones**

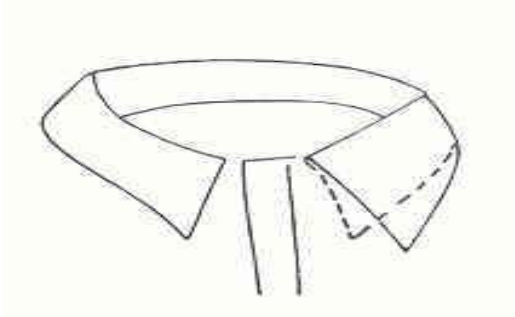
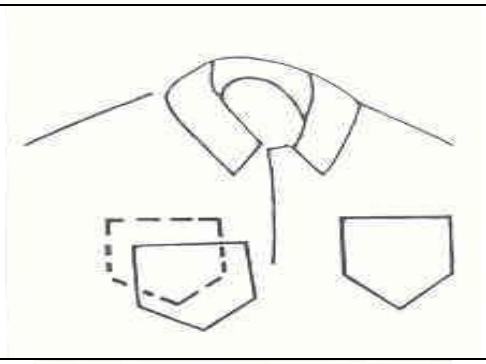
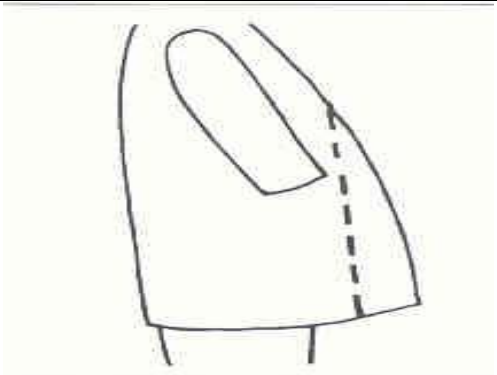
The following diagrams showing major and minor apparel defect zones A,B and C

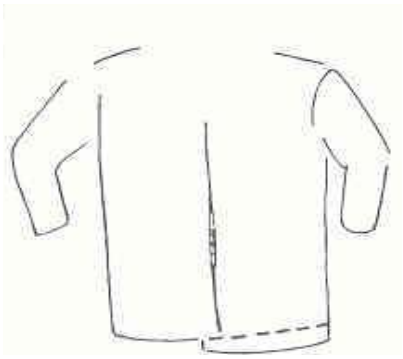
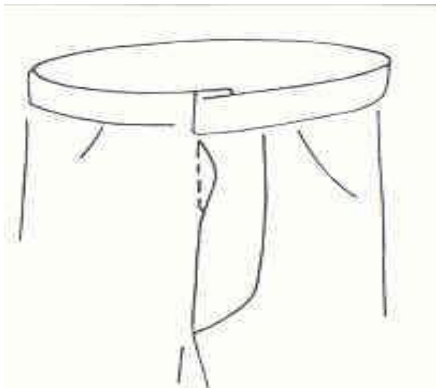
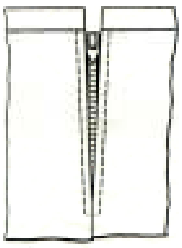
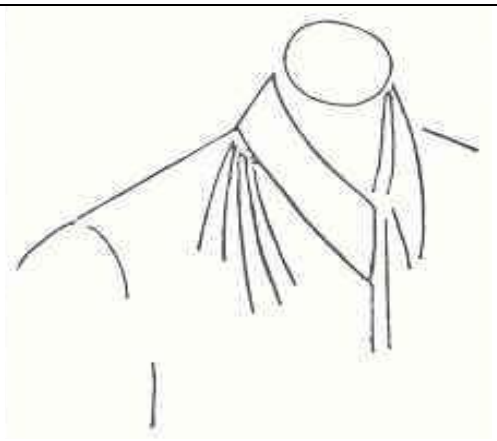
- A defect in "A" zone is considered more serious than a defect in "B" zone
- A defect in "B" zone is considered more serious than a defect in "C" zone and will be categorized accordingly.

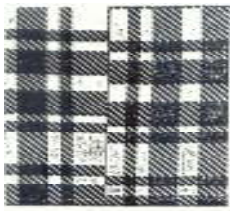
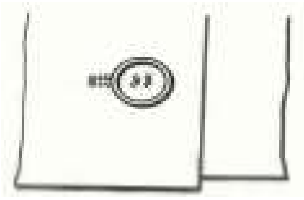
**FIGURE : 2.1 DEFECT ZONES**



## TABLE : 2.3 COMMON GARMENT DEFECTS

| Defect name | Defect class | Picture |
|---|---|---|
| Uneven collar | MAJOR |  |
| Misaligned crooked point | MAJOR |  |
| Twisted pant legs | MAJOR |  |
| Hiking | MAJOR |  |

| Defect name | Defect class | Picture |
|---|---|---|
| **Uneven back vent** | **MAJOR** |  |
| **Fullness in fly** | **MAJOR** |  |
| **Zipper open** | **MAJOR** |  |
| **Puckering in collar** | **MAJOR** |  |

| Defect name | Defect class | Picture |
|---|---|---|
| **Sleeve hanging backwards** | **MAJOR** |  |
| **Mismatched lines** | **MAJOR** |  |
| **Front placket up/down** | **MAJOR** |  |

## 2.9.1 CUTTING DEFECTS

Cutting room defects includes pattern grading defects, marking defects, spreading and cutting defects which is discussed under.

**a. Pattern Grading Defects**

**1. Grade Not Conforming to Specification measurements:**

Finished product not measuring to specified dimension and component parts not fitting in relationship to notches, openings and seams such as armholes, sleeve heads, neck bands, neck opening, side seams, inseams, waist measurements etc

**2. Distorted Grading**

Unbalanced patterns which would cause twisted seams, puckering, pleating and a general uneconomical yardage waste.

**b. Marking Defects**

**1. Shaded Parts**

All component parts not included in same section

**2. Pieces not Symmetrical**

Will not sew together without puckering or pleating

**3. Not Marked by Directional Lines**

Bias will not fit together, causing twisting, puckering, pleating and a general mismatching of component parts.

**4. Skimpy Marking**

Marker did not use outside perimeter of pattern. Pattern moved after 'partially marked to fit into space.

**5. Notches and Punch Marks**

Left out, not clearly marked or misplaced.

**6. Marker Too Wide**

Parts will not catch in lay, causing skimpy garments or requiring recuts.

**7. Marker Too Narrow**

Result in wasted material.

**8. Mismatched Plaids**

Marker did not block component parts to match.

**9. Misdirected Napping**

Patterns not marked in same direction on napped fabrics.

**c. Cutting Defects**

1. **Marker or Perforator**

   Not stapled or stenciled on lay to catch both edges, causing parts to miss in cutting. Lay too tight or too loose, distorting dimensions of garment. Perforated stencil not powdered or inked, sufficiently to show distinct lines, notches and punch marks.

2. **Misplaced Piece Rate Tickets or Bundle Members:**

   Attached to, or marked on, wrong bundles, causing mixed. Sizes or / and shades.

3. **Drill Marks**

   Drill marks misplaced, not perpendicular, omitted or wrong side drill used.

4. **Opening Slits**

   Cut under, above, to the side or at incorrect angle. Not cut through entire bundle or omitted.

5. **Improper Cutting**

   Not following marker lines, resulting in distorted parts. Letting knife lean, causing top and bottom ply's to be of different sizes.

**6. Notches**

Misplaced too deep or too shallow or omitted.

**7. Oil Spots**

Equipment improperly oiled or cleaned.

**8. Improper Knife Sharpening**

Causing ragged, frayed or fused edges on bundles

**9. Knife or Scissors Cut**

Piece damaged by over run in cutting previous piece.

**d. Shade Marking Defects**

**1. Pencil or Machine Marking**

Too dark, too light, bleeding through, not legible or marked on wrong side.

**2. Stains**

Ink stains from stamping or pin ticket machines.

**3. Thermo ply or Pin Ticket Marking**

Improperly placed or marked.

**e. Take Off and Bundling Defects**

**1. Not Stacked in Numerical Order**

Bundle numbers not in order on rack, skid or box.

**2. Matching Linings**

Matching wrong size or wrong material

### 2.9.2 SEWING DEFECTS

**Introduction**

Sewing defects like needle hole damage, feed damage, skipped stitches, thread break, broken/joint stitches, seam pucker, pleated seam, uneven stitch, oil

spots/stains and poorly formed stitches, incorrect shape of sewing line, insecure back stitch, twisted seam, mismatched checks/stripes, reversed garment parts, wrong seam type, wrong shade of thread etc. are some sewing defects that could occur so should be taken care of. Various other sewing defects are discussed below and Table 2.4 with pictures and defect class.

## Defects of sewing

### 1. Pleated Seams

Machine sewing parts too large or small for fabric or seam desired, irregularly cut patterns or fabric irregularities and operator feeding fabric faster than normal feeding action of the machine.

### 2. Insecure Backstitching

Original stitch row not covered with second seam.

### 3. Wrong Shade of Thread

It is either caused by basic purchasing error, manufacturing defect by thread supplier or operator selecting wrong color from thread bin.

### 4. Irregular Gauge of Stitching

Not using correct sewing machine or using single needle machine where a multiple needle machine is required.

### 5. Run Offs

Operators not following marking or not using mechanical aids such as edge guides to assure uniform stitching.

### 6. Wrong Seam or Stitch Type

It is due to management error in selection or operating personnel failing to follow specifications.

**7. Loose Thread Tension**

Tension in machine is not adjusted correctly by operator.

**8. Tight Thread Tension**

Tension in machine is not adjusted correctly by operator.

**9. Wrong Stitches per Inch:**

It occurs normally caused by operators who lengthen stitch to increase machine speed.

**10. Closures Omitted**

It occurs normally an oversight by operators or failure by inspectors.

**11. Closures Misplaced**

Inattention or inexperience by operating personnel, or improper alignment with gauges

**12. Finished Components Not Measuring to Tolerances**

It could be caused by faulty pattern, cutting, previous operations in stitching or by indifferent operator attention to the specified tolerance.

**13. Dimensions out of Tolerance**

It could be caused by faulty pattern, cutting, previous operations in stitching or by indifferent operator attention to the specified tolerance.

**14. Omission of Any Pan of Garment**

Poor work flow, inattentive operator, and wrong work tickets or poor inspection.

**15. Misaligned Closure**

Closure components do not line up.

**16. Misplaced Component**

Where part not positioned according specifications.

**17. Misaligned Seam**

Where seams .do not line up or cross specified point.

**18. Needle Pick**

Failure of operator to replace a dull needle

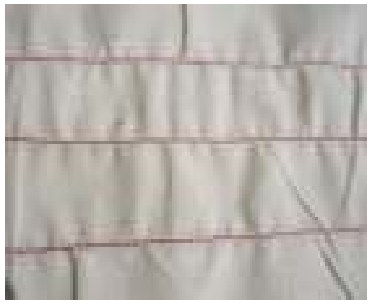
**19. Caught Place**

Where a component part of a garment has been caught in an unrelated operation

**20. Reversed Pieces**

Where piece is sewn with face side opposite from specification; where part cut for one side of garment sewn in other.

**TABLE: 2.4 SEWING DEFECTS**

| Defects Name | Defect class | Pictures |
|---|---|---|
| **Improper over edge stitch:** Caused due to improper handling of the fabring while sewing. | **MAJOR** |  |
| **Puckering** An irregular seam surface usually caused by a) Inherent fabric characteristic, b) needle puncture. c) machine feed slippage or d) incorrect machine application | **MAJOR** |  |

| Defects Name | Defect class | Pictures |
|---|---|---|
| **Open seam**<br>Incorrect folder or poor operator technique. Sometime. Results from poor selection of type of seam for fabric used or purpose of seam in garment | **MAJOR** |  |
| **Pocket smiling:**<br>Caused because of operator unskilled and carefulness | **MAJOR** |  |
| **Broken stitch**<br>Often times the fault of wrong type of stitch for specific seam construction. Could be caused by ex· Excessive tightness in machine tensions. | **MAJOR** |  |
| **Run off**<br>Operator not following marking or not using mechanical aids such as edge guides to assure uniform stitching. | **MAJOR** |  |
| **Seam grinning:**<br>Caused by stitches are not made properly similar to loose stitch | **MAJOR** |  |

| Defects Name | Defect class | Pictures |
|---|---|---|
| **Uneven stitch width**<br>Caused by operator speeding up machine too rapidly or by holding back or pushing- fabric through machine in variance with correct machine feed. | **MAJOR** |  |
| **Uneven stitch**<br>Caused by operator speeding up machine too rapidly or by holding back or pushing- fabric through machine in variance with correct machine feed. | **MAJOR** |  |
| **Holes**<br>Damage caused by faulty machine or related equipment. | **MAJOR** |  |
| **Skip stitch**<br>Caused. by machine malfunction or excessive needle. heat due to friction. | **MAJOR** |  |
| **Loose stitch**<br>Can be caused either by malfonned stitching or poor trimming techniques | **MAJOR** |  |

| Defects Name | Defect class | Pictures |
|---|---|---|
| **Needle hole visible**<br>Frequent ripping of the fabric | **MAJOR** |  |
| **Mismatched lines**<br>Where seams .do not line up or cross specified point. | **MAJOR** |  |
| **Sewn with stickers**<br>Improper checking in cutting and also the operator carelessness | **MAJOR** |  |

### 2.9.3 ASSEMBLY DEFECTS

Assembling is the most important department/ section of a garment manufacturing industry. Sewing machines of different types are arranged as a vertical line to assemble the garments. Sequence of types of sewing machine arrangement depends on sequence of assembling operations. Number of sewing machine per line varies from 20 nos to 60 nos depending on the style of the garment to be produce. The following are certain defects occurred due to assembling.

- ✓ Finished components not correct to size/shape/symmetry
- ✓ Components/parts wrongly positioned
- ✓ Garment parts pleated/twisted/showing bubbles/fullness
- ✓ Parts shaded
- ✓ Wrong one way direction
- ✓ Mismatched trimming

## 2.9.4 PRESSING

Pressing is the application of heat moisture and pressure to shape, mold or crease fabrics, garments or garment parts into geometric forms intended by the designer. Pressing makes the final presentation of the garment, ready for sale. Pressing consists of four elements such as heat, moisture, pressure and vacuum shown in Table 2.5 and defects related to pressing in Table 2.6.

**TABLE: 2.5 ELEMENTS OF PRESSING**

| S.NO | PRESSING ELEMENTS |
|---|---|
| 1. | Heat-to soften, stabilize and set the desired shape |
| 2. | Pressure- to alter shape and increase the permanency of crease |
| 3. | Moisture- to transfer heat to the fibres of the fabric |
| 4. | Vacuum- for removing the residual moisture |

**Table: 2.6 PRESSING DEFECTS**

| Pressing defects | |
|---|---|
| Pressing Omitted/Burned / Scorched Garments: | Caused due to improper settings of machine and mishandling by operator. |
| Improper Pressing Over Zippers or Other Closures. | Often produces a tear or unsightly impression on the face of the garment. |
| Pockets or Linings not Pressed Correctly: | Causing wrinkles or ridges to appear on the surface of the garment. |
| Pressing Producing a Shine in Fabric | Usually caused by excessive heat or incorrect type of pressing surface. |
| Inadequate Pressing | Excessive heat or pressure resulting in poor pleating, fullness or twisting of a seam or garment surface. |
| Garments not thoroughly Dried | Resulting in excessive wrinkling of garment. |

## 2.9.5 FINISHING AND PACKAGING DEFECTS

Finishing includes trimming defects, folding Defects, pressing defects etc. which are discussed below and packing defects in table 2.7.

### a. Trimming Defects

**1. Thread not Trimmed or Threads not trimmed to specified Length**

Self-explanatory

**2. Cuts or Nicks**

Caused by indifferent handling of scissors, snips or mechanical trimmers

**3. Seam Tears**

Frequently caused by the turning equipment used to reverse garments in finishing

**4. Soil**

Caused by oil, grease or dirt

Often times originating from a dirty work area or machinery not properly cleaned.

**5. Streaks**

Marking caused by some types of turn boards or defectively finished trimmings.

### b. Folding Defects

**1. Garment not folded to Specifications**

Self-explanatory

**2. Garment not folded with proper Materials**

Cardboard, tissue or other specified packaging materials omitted

**3. Pins or Folds in Garment Incorrect**

Pins in wrong location or folds not correctly aligned for package.

**4. Garments not buttoned, fly's not Closed, Incorrect number of pins**

Self-explanatory

**5. Label not showing**

Garment not positioned in package to show label on top surface.

**c. Pressing Defects**

**1. Scorch**

Equipment temperature too high for fabric: garment subjected to pressing beyond specified limits, or not conditioned properly prior to pressing.

**2. Water Spots**

It is caused by leaks in pressing unit or improper steam.

**3. Closure Damage**

Closed pressure of press too great, insufficient press padding

**4. Damp Finish**

Vacuum system in need of draining, steam too moist

**5. Shine or Glass Finish**

Incorrect combination of heat, pressure and press covering

**6. Flattened Nap**

Pressing on incorrect equipment

**7. Grid Plate Mark**

Incorrect selection of grid plate and/or padding

### d. Packing Defects

**TABLE: 2.7 PACKING DEFECTS**

| **Packing defects**: | |
|---|---|
| Use of correct container | The package is not suitable for the use to which it will be part<br>Shipping consumer display. |
| Position of garment in the container | Garment no adequately positioned which may result in distortion of the products presentation. |
| Poorly Packed in Carton | Causing chafing or crushed comes in transit which weakens thread. |

## 2.10 LET US SUM UP

Environmental pollution and global warming will have to be considered while producing textile materials. The eco-problems in textile industry occur during some production processes that make a toxin and swells into our ecosystem. Also specifications with regard to harmful chemicals are to be considered in processing the textiles. Therefore eco management in textile and apparel industry helps to improve the industry and reduce the impact on eco system.

## 2.11 LESSON END ACTIVITIES

1. Collect information about environment friendly textiles that you find in market.

2. Organic cotton: A route to eco-friendly textiles. Discuss

## 2.12 REFERENCES

1. Managing quality in apparel industry, Pradeep V Mehta, NIFT Publications

2. An Introduction to quality control for the apparel industry, Mehta P V, Marcel Dekker

## UNIT- III

### OBJECTIVES

This unit will help you to under stand –

- Eco specification & restrictions in apparels and textiles
- The awareness and restrictions coming in to ecology of textiles
- Chemicals on textiles and their prescribed limits
- How Eco specification helps to tackle business challenges

### STRUCTURE

3.1 Eco Specification & Restrictions In Apparels And Textiles
3.2 Dry Cleaning Using Ozone
3.3 Depleting Chemicals
3.4 ph Values
3.5 Formaldehyde Contents
3.6 Heavy Metal Contents
3.7 Pesticides and Herbicides
3.8 Azo Dye Stuffs
3.9 Nickel
3.10 Pentachlorol Phenols
3.11 Colour Fastness
3.12 Brighteners
3.13 Softening Agents
3.14 Let Us Sum Up
3.15 Lesson End Activities
3.16 Reference

## 3.1 ECO SPECIFICATION & RESTRICTIONS IN APPARELS AND TEXTILES

With the kind of awareness and restrictions coming in to ecology of textiles world over, the first thing every textile processor need to know prior to processing any textile material is the end use of the textile being processed and the country to which being exported.

Because each end use, e.g. baby wear, clothing in direct contact with skin, furnishing fabrics etc. will have different specifications just as each country will have different legislation.

Broadly, the restrictions concern the presence of following chemicals on textiles beyond prescribed limits.

**Chemicals on textiles beyond prescribed limits**

- Prohibited amines in azo dyes
- Phenols
- Formaldehyde
- Extractable heavy metals
- Residual pesticides
- Allergenic dyes
- Benzenes& toluene's compound
- Phthalates

There has been a significant increase over the past few years in the use of eco-labels, i.e. environmental labels attached to a variety of products to attract the attention of consumers about the environmentally positive features of the

products. Generally these labels are voluntary and mostly used for the promotion of the products on the basis of their environmentally friendly characteristics. In the case of textiles and clothing there are for the time being no eco-labels the use of which has been enforced by mandatory rules.

To enhance awareness about the environmental impacts of products, the Ministry of Environment and Forests (MoEF), Government of India (GoI) has initiated a scheme in 1991, which is basically a scheme of labeling the eco-friendly products .It is known as "Ecomark" scheme and aims at easy identification of eco-friendly products. The scheme is based on a "cradle to grave" approach and takes into account the impact of a product from the raw material extraction, to manufacturing, and to final disposal. An earthen pot has been chosen as a logo for the eco-mark scheme.

'Eco' specification helps to tackle some of the biggest challenges facing our business and world. Work with our customers and our suppliers to combat climate change, reduce waste, safeguard natural resources, trade ethics and build a healthier nation by

- ✓ Becoming carbon neutral
- ✓ Send no waste to landfill
- ✓ Extend sustainable sourcing
- ✓ Help improve the lives of people in our supply chain
- ✓ Help customers and employees live a healthier life-style

For example :

**Climate change**- The educational campaign in 2007 encourages people to wash clothes at 30 degrees to cut energy use and CO2 emissions. By dropping wash temperatures from 40°C to 30°C you can save around 40% energy – good for both the environment and your bank balance.

**Reduce waste**- Reducing the weight of non-glass packaging by 25%.

**Sustainable raw materials** - Reducing the environmental impact of the textiles sell by selling new fibres such as bamboo, renewable plastics and new ways of producing fibres such as organic cotton, linen and wool.

**Garment Product Using Eco Friendly Textile**

**Recycled polyester**

Formal trouser

Fleece jacket

**Organic cotton**

Formal shirt

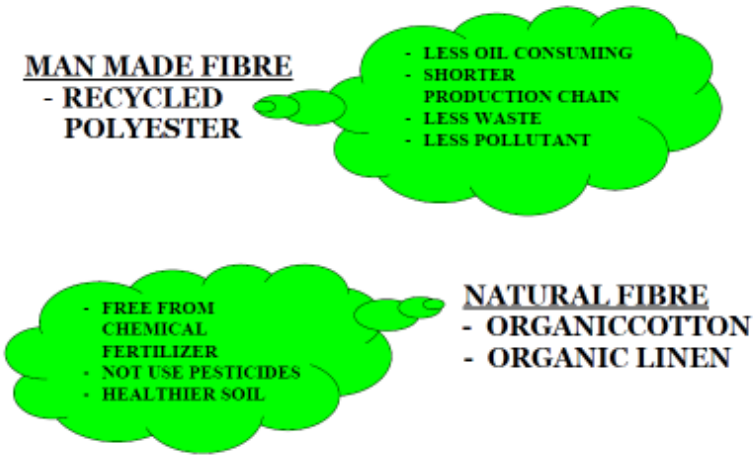
Casual shirt

Formal trouser

**Organic linen**

Casual shirt

**FIGURE.3.1 GARMENT PRODUCT USING ECO FRIENDLY TEXTILE**




## 3.2 DRY CLEANING USING OZONE

Dry cleaning is any cleaning process for clothing and textiles using a chemical solvent other than water.

## Ozone Dry Cleaning System

Ozone Dry Cleaning System long a staple in the dry cleaning and remediation industries, the use of Ozone is undergoing somewhat of a renaissance as more powerful Ozone Generators and larger and more sophisticated systems like the Ak47 are entering the market.

Ozone is an environmentally-friendly substance that removes smells from garments including smoke, urine, vomit, cigars, skunk and other substances that "linger" even after repeated washings. Ozone is made from Oxygen or 02 and converted to Ozone or O3 by Ozone Generators. While it is fairly easy to make Ozone through Corona Discharge (such as a lightning bolt), modern Ozone Generators have left much of the problems of the older systems behind.

In any chemical application, concentration is important. Gone are the days of old UV-style Ozone systems that put out a very low concentration of Ozone and required hours of contact time. Large Ozone generating systems can now be used to quickly fill rooms and cut down on treatment times considerably. Prices of these systems have dropped substantially as systems become more available.

Ozone Dry Cleaning System

- Is very effective in killing germs that it comes in contact with.
- Will kill up to 99.99% of bacteria in the gear.
- Is a Chemical free process.
- Will not need any special oils, solvents or bleaches.
- It dries your sweat soaked gear while simultaneously disinfecting and deodorizing.

## 3.3 DEPLETING CHEMICALS

### Ozone Depleting Chemicals

Ozone depleting chemicals include Chlorofluorocarbons (CFCs) and Halons. CFCs are versatile, and are used as refrigerants, cleaners, solvents, sterilants, and propellants in the manufacture of insulation, fast food cartons, and electronic items. They are organized compounds that are non-toxic, long-lived, and non-flammable.

Halons are close cousins of CFCs that utilize bromine instead of chlorine in their chemical structure. Halons are used in fire extinguishers as they are safe, effective, and gentle to water sensitive materials.

### CFCs and Halons act as greenhouse gases

An increase in UV-B wavelength radiation also has adverse effects on the earth itself. There is evidence that it affects plant productivity by affecting photosynthesis, and marine organisms such as phytoplankton. Both CFCs and Halons act as greenhouse gases as well as ODCs, thereby increasing global warming.

## 3.4 PH VALUES

pH is a measure of hydrogen ion concentration or more precisely in the hydrogen ion activity. pH is the most important parameter as it indicate instantaneously the acidic or alkaline condition of an effluent (or water), all treatment process are based on pH values only.

The applications of pH values are numerous. Noted among them are

1. Use full to determine the type of treatment applied to the effluent.

2. The efficiency of treatment can be judged.

3. The treatment to various desired levels can be carried out.

pH meters are the widely employed instruments for the measurements of pH. In addition to table model pH meters, portable once especially pen type (resembling pen) are now available with digital readout.

**Know about pH VALUE**

- Acidic and basic are two extremes that describe a chemical property chemical.
- Mixing acids and bases can cancel out or neutralize their extreme effects.
- A substance that is neither acidic nor basic is neutral
- The pH scale measures how acidic or basic a substance is
- The pH scale ranges from 0 to 14.
- A pH of 7 is neutral
- A pH less than 7 is acidic
- A pH greater than 7 is basic
- pH is the negative logarithm of the concentration of hydrogen ions in an aqueous solution.
- Some liquids are acidic having more hydrogen ions.
- Some are basic having more hydroxyl ions
- Pure water is neutral
- But when chemicals are mixed with water, the mixture can become either acidic or basic.
- Examples of acidic substances are vinegar and lemon juice
- Milk of magnesia and ammonia are examples of basic substances.

**Effects of pH**

- Extreme alkalinity makes the receiving water unfit for any purpose.
- It is harmful to most of the aquatic life
- High acidity will cause corrosion of machineries

Human skin is slightly acidic which inhibits the development of many diseases. Textiles where the pH lies in neutral (pH 7) or in slightly acidic regions (below 7) are friendly to skin. Fabrics with extreme pH values can easily damage skin and may cause allergic reactions.

## 3.5 FORMALDEHYDE CONTENTS

Formaldehyde is also known as methanol, methylene oxide and Oxo methane. At room temperature, formaldehyde is a colourless, flammable gas with a distinct pungent smell. It is present in nature in small quantities. For example, human blood has traces of formaldehyde and so do apples. However, in large quantities it may be a skin irritant and so the use of Formaldehyde levels in textile mills and apparel factories have been reduced considerably.

Formaldehyde acts as a cross-linking agent to make an easy-care finish, intended to prevent shrinkage, and gives the product crease-resistant and smooth-dry properties. Release of Formaldehyde can be harmful to health through irritation of mucous membranes and the respiratory tract.

**Sources of formaldehyde in textiles**

- ✓ Used as a mordant (dye fixing agent)
- ✓ Fixers and binders in pigment printed fabrics
- ✓ Anti-shrinking treatments
- ✓ Resin finishes for wrinkle/crease-free properties
- ✓ Tanned leather products and cosmetics

**Hazards**

- ✓ Low levels of formaldehyde can cause irritation of the eyes, nose, throat and skin
- ✓ People with asthma maybe more sensitive to the effects of inhaled formaldehyde
- ✓ In animal studies, rats exposed to high levels of formaldehyde in air developed nose cancer
- ✓ Allergenic and skin irritant in large quantities
- ✓ The department of Health and Human Sciences has determined that formaldehyde may reasonably be anticipated to be a carcinogen.

**Limits**

- ✓ The occupational safety and Health Administration has set a permissible exposure limit for formaldehyde of 0.75 ppm for an hour workday.
- ✓ The short term exposure limit of 15 minutes is 2 ppm.

**Typical buyers limit**

- ✓ Babies wear 20 mg/kg.
- ✓ Items in direct contact with human skin 75 kg/kg.
- ✓ Outer wear 300 mg/kg.

**Special remarks**

- ✓ Formaldehyde will evaporate if kept in a ventilated area or even during handling of samples.
- ✓ Test materials should therefore be sent in sealed poly bags and individually packed.

## 3.6 HEAVY METAL CONTENTS

"Heavy metal" is defined as any metallic element that has a relatively high density and is toxic or poisonous at low concentrations. Heavy metals are constituents of some dyes and pigments. They can also be found in natural fibres due to absorption by plants through soil. Metals may also be introduced into textiles through dyeing and finishing processes. After chemical processing of textiles, waste water contains many impurities as well as chemicals. Effluents from textile dyeing process contain heavy metals. These metals are toxic as their ions or compounds are soluble in water and may be readily absorbed into living organisms. Once absorbed by humans, heavy metals tend to accumulate in internal organs such as the liver or kidney. The effects on health can be tremendous when high levels of accumulation are reached. For example, high levels of lead can seriously affect the nervous system. After absorption, even in small amounts these metals bind to structural proteins, enzymes and nucleic acids causing health effects. The toxicity of metal pollution is slow and long lasting as these metal ions are non-degradable.

Heavy metals are natural components of the Earth's crust. They cannot be degraded or destroyed. Interestingly, small amounts of these elements are common in our environment and diet and are actually necessary for good health. Lead can even be found in natural fibres, such as cotton, flax and hemp, which can absorb it from the environment.

**Heavy metals very often refer to:**

- Antimony (Sb)
- Arsenic (As)
- Lead (Pb)
- Cadmium (Cd)
- Mercury (Hg)

- Copper (Cu)
- Chromium (Cr)
- Cobalt (Co)
- Nickel (Ni)

Both Cadmium and Lead are classified as carcinogens. Cadmium has been restricted in Europe for a time. Lead is restricted in the U.S. under the Consumer Product Safety Improvement Act (CPSIA) in addition to certain European regulations.

**Sources of heavy metals**

- Oxidizers (especially for vat and sulphur dyes)
- After treatments of direct dyes
- Metal catalyst for curing resins (Zinc, mercury)
- Flame retardant, soil release & water repellent finishes
- Dye stripping agents such as permanganate, zinc sulfoxylate etc.
- Dye stuffs and auxiliaries.
- Stabilizer in plastic zippers and buttons (Cadmium)

**Limits**

There are no legal limits for heavy metal contents in textiles. However, eco-labels and buyers have adopted limits of drinking water for textile end products. Maximum permissible limits of heavy metals in drinking water according to Indian Standards are less than 1 ppm in almost all the cases.

**Removal of heavy metals**

Several techniques are used to remove the heavy metals from textile effluent namely Coagulation, precipitation, absorption, ion exchange, magnetic separation, liquid-liquid extraction, membrane filtration etc.,

**Real fact**

Each year the global textile industry discharges 40,000 to 50,000 tons of dye into our rivers, and more than 200,000 tons of salt. Remember that if the average exhaustion rate is 80% for most dyes (i.e. that 20% of the dye stuff is expelled with the waste water). Then that means: 80% of the dye stuff remains in the fabric. In other words, those toxic chemicals remain in the fabrics you bring into your homes.

According to an analysis done by Levis Strauss and Company it takes 3481liters of water and 32 kg of CO2 to produce one pair of jeans. For instance, toxic runoff in China's booming textile industry is one reason why many of the nation's largest rivers resemble open sewers and 300 million people lack access to clean drinking water.

**Health problems**

Prolonged exposure to heavy metals may cause health problems such as kidney failure, emphysema, allergies and even cancer.

- Copper – irritation of mucous membrane.
- Iron-contact with skin and eyes causes severe burns
- Manganese-symptoms of Parkinson's disease
- Aluminium probable cause for Alzheimer's & Parkinson's disease
- Zinc-gastrointestinal problems and damage to kidneys
- Selenium nausea, diarrhoea, fatigue & hair loss
- Lead – affects central nervous system
- Mercury affects central nervous system and the areas associated with visual and auditory function.
- Cadmium kidney failure
- Nickel – irritation of skin and eyes and dermatitis

- Chromium – Long continuous exposure may lead to liver and kidney disease and even cancer.

Among the different heavy metals iron, copper, aluminium and tin are considered more safe compared to lead, chromium, cadmium and mercury.

## 3.7 PESTICIDES AND HERBICIDES

Pesticides are used in the cultivation of natural plant fibers like cotton to combat insects, and also as a moth protection agent during storage. Herbicides are weed-eradication and defoliant chemicals. They can be absorbed by the fibers and might remain in the final product. Most of them can be removed during subsequent wet processing. Pesticides and herbicide residues are rated slightly too strongly toxic and are sometimes easily assimilated through the skin.

We're often asked if there are traces of pesticides in conventionally grown natural fibers – because people make the assumption that if pesticides are used on the plants, then there must be residuals in the fibers. According to the modern agricultural industry, cotton agriculture uses integrated pest management (IPM) systems to promote cotton's environmental stance (author's note: reduction of costs doesn't hurt either).As the result, the use of chemicals on cotton crops is down: On average "only" 20 lbs. of pesticides are applied to an acre of cotton today – as opposed to about 40 lbs. in the past.

## 3.8 AZO DYE STUFFS

Azo dyes are synthetic organic compounds characterized by containing one or more nitrogen. Nitrogen double bonds called azo groups in their chemical structure: N=N. They are the most important chemical class of dyes, representing 60-70% of all dyes. They are usually red, brown or yellow.

Azo dyes are commonly used as colouring agents in the textile and leather industry, especially in developing countries. But since the 1990's when EU

legislation was introduced restricting certain azo dyes, misunderstandings have emerged about these dyestuffs.

**Hazards of azo dyes:**

Azo dyes are manufactured from aromatic amines. It is important to note that some of them can split off carcinogenic amines, such as benzidine, which may be absorbed through skin and the respiratory and intestinal tract. Non-fixed, water-soluble azo dyes can also come into contact with skin through perspiration fluid. Other internal parts, for instance in liver, azo compounds can be broken down by certain enzyme systems.

## 3.9 NICKEL

Nickel is found in alloys used for metal accessories on garments such as buttons, zippers and rivets. Some people are allergic to nickel and may experience serious skin irritation when in contact with nickel-containing accessories for an extended period.

Nickel presence is known to cause contact dermatitis in approximately 10% of the European population. Therefore, a regulation restricting the amount of Nickel that is released by metal accessories was necessary. Use of nickel was restricted in metallic accessories by many countries in Europe, due to the potential to cause skin allergies.

**Reasons for nickel sensitivity**

Ear piercing is an important risk factor for nickel sensitivity. Traditionally higher in females, its occurrence may change with men having pierced ears today and both sexes increasing the piercing of other body parts. Ear piercing may cause increased reaction to other metals such as gold and mercury.

**Nickel exposure**

- ✓ Examples of exposure to nickel include:
- ✓ Clothing snaps and buttons
- ✓ Hooks and gartar snaps
- ✓ Rivets and zippers
- ✓ Identification tags
- ✓ Watch straps
- ✓ Blue jeans buttons
- ✓ Scissors and knitting needles
- ✓ Jewellery
- ✓ Thimbles
- ✓ Coins, keys and buckles

**Nickel sensitization**

- ✓ Nickel sensitization is aggravated in body locations when sweat leaches the nickel out of metal.
- ✓ Nickel may produce either allergic contact dermatitis or urticaria
- ✓ With contact urticaria from nickel in necklaces not made of sterling silver or a high percent of gold, the neck begins to itch almost immediately and turns red. Nickel may cause a runny nose and other type I allergic symptoms.
- ✓ Jewellery can be tested chemically for nickel with a simple spot test
- ✓ Some companies make special jewellery for people sensitive to nickel or other metals.

## 3.10 PENTACHLOROL PHENOLS

Pentachlorophenol (PCP) is a synthetic substance that was first produced in the 1930s. It is marketed under the trade names, Santophen, Pentachlorol, Chlorophen, Chlon, Dowicide 7, Pentacon, Penwar, Sinituho and Penta among

others. It can be found in two forms: PCP itself or as the sodium salt of PCP, which dissolves easily in water. In the past, it has been used as a herbicide, insecticide, fungicide, algaecide, disinfectant and as an ingredient in antifouling paint. Some applications were in agricultural seeds (for nonfood uses), leather, masonry, wood preservation, cooling tower water, rope and paper mill system.

To prevent mold spots caused by fungi, chlorinated phenols like PCP are applied directly on textiles. PCP is very toxic and regarded as a cancer-inducing agent. In textile and leather industry, PCP is mostly used for preservation finishing; in ligneous products PCP can be used in conservation paints.

In Germany, import and trade of products containing more than 5 ppm PC (pentachlorophenol), pentachlorophenol sodium, all pentachlorophenol salts and compounds in products is prohibited. In practice, the low maximum concentrations allowed in Germany imply that the use of PCP is prohibited. The legislation in Germany is stricter than the EU legislation concerning PCP (maximum 0.1% by weight (1000 ppm).

**Toxicity**

PCP and its salts are highly toxic for aquatic systems, harmful to human health and highly persistent in the environment. Products containing PCP may form highly toxic substances when they are incinerated.

Short-term exposure to large amounts of PCP can cause harmful effects on the liver, kidneys, blood, lungs, nervous system, immune system, and gastrointestinal tract. Further, elevated temperature, profuse sweating, uncoordinated movement, muscle twitching, and coma are additional side effects.

Contact with PCP (particularly in the form of vapor) can irritate the skin, eyes, and mouth. Long-term exposure to low levels such as those that occur in the

workplace can cause damage to the liver, kidneys, blood, and nervous system. Finally exposure to PCP is also associated with carcinogenic, renal, and neurological effects. The EPA classifies PCP in group B2 (probable human carcinogen).

## 3.11 COLOR FASTNESS

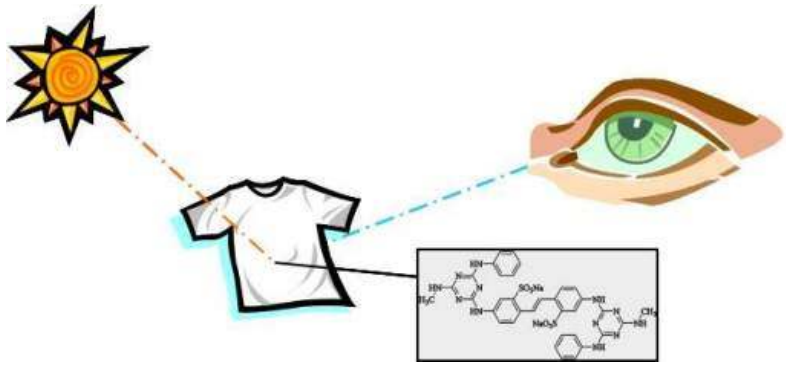
Colour fastness is a term used in dyeing of textile materials means resistance of colour to fading, i.e. it refers to the notion of an object having colour that retains its original hue without fading or running. The term is usually used in the context of clothes. The first known use of the word colourfast was in 1916.

In general, clothing should be tested for colourfastness before one uses bleach, or another type of strong cleaning product. Light fastness, wash fastness, and rub fastness are the main ones that are standardized. The light fastness of textile dye is categorized from one to eight and the wash fastness from one to five. The higher the number the better fastness is obtained.

## 3.12 BRIGHTENERS

Optical brighteners also called optical brightening agents (OBAs), fluorescent brightening agents (FBAs), and/or fluorescent whitening agents (FWAs) or "synthetic fluorescent dyes" – work a bit differently. Optical brighteners are chemicals similar to dyes which absorb ultraviolet light and emit it back as visible blue light. The blue light emitted by the brightener compensates for the diminished blue of the treated material and changes the hue away from yellow or brown and toward white.

**FIGURE: 3.2 WORK OF OPTICAL BRIGHTENERS**



They are designed to mask yellow or brown tones in the fibers and make the fabric look cleaner and brighter than it would otherwise appear to the naked eye. In other words, the undesirable color is made invisible to the eye in an "optical manner". Optical brighteners are used both on natural fibers (cotton, linen, silk, hemp) as well as in polymer melts for polyester and other synthetic fiber production.

Optical brighteners aren't effective unless they remain in the fabric, and persist after washing. They only last so long, until the point when they actually burn out and no longer do anything. They are also subject to fading when exposed long term to UV.

**How does an optical brightener works?**

- Optical brighteners are added to detergents upto 0.2% in order to counter the natural yellowing of fabrics as they age.
- Creates whiter than white surface
- Gives ultra-clear effect
- Doesn't get clothes any cleaner but simply makes them look that way
- Eco restrictions of optical brighteners

- ✓ The use of optical brighteners is to be avoided to the utmost extent in the production of baby bibs, underwear and nappies
- ✓ Many of the chemicals in this category are toxic to fish and other aquatic animals.
- ✓ Some are also capable of causing mutations in bacteria
- ✓ Optical brightness are also very slow to biodegrade
- ✓ Once they are introduced into local water ways via household waste water, they will remain there as pollutants for some time.
- ✓ In terms of human health, exposure can cause eye irritations and skin reactions in sensitive individuals.
- ✓ There are some remarks that fluorescent dye stuffs may cause skin irritation and allergic reactions and are suspected of being a cause of cancer and an endocrine disrupted.
- ✓ Many laundry detergents that promise whiter clothing actually use optical brighteners to make laundered clothes appear “whiter”.
- ✓ In truth, dirt and bacteria still linger on clothes.
- ✓ Unfortunately, brighteners can cause allergic reactions like dermatitis when they come in contact with skin.
- ✓ Fluorescent agents like phosphors can also be absorbed by the body when you sweat through the clothes.
- ✓ Flushing it out creates a burden on the kidneys.
- ✓ There is a growing suspicion that long-term exposure to phosphors may lead to cancer.

**Problems with optical brighteners**

Some brighteners have been proven to cause allergic skin reactions or eye irritation in sensitive people. They are known to be toxic to fish and other animal and plant life and have been found to cause mutations in bacteria.

Most OBAs are not readily biodegradable, so chemicals remain in wastewater for long periods of time, negatively affecting water quality and animal and plant life. It is assumed that the substances accumulate in sediment or sludge, leading to high concentrations. In wastewater, OBAs can also leach into groundwater, streams, and lakes. Since fluorescence is easy to detect, optical brightener monitoring is an emerging technique to quickly and cost-effectively detect the contamination of storm water by sanitary wastewater.

REACH is the new European Union regulation which aims to improve human health and the environment through better and earlier identification of the properties of chemical substances. **REACH** stands for **R**egistration, **E**valuation, **A**uthorisation and *R*estriction of **Ch**emical substances.

**TABLE: 3.1 Textile Brighteners**

| Name | C.I. Code | Application |
|---|---|---|
| ER | C. I. 199 | ER is suitable for whitening of staple polyester fibre and making liquid. |
| ER- II | C. I. 199:1 | Brightener of polyester fiber & its staple fiber and making liquid. |
| ER-330 | C. I. 199 | Outstanding brightener for polyester fiber and T/C, T/S, and T/W blends. |
| DT | C. I. 135 | Whitening agent for polyester fiber and T/C, T/S, and T/W blends. |
| EB-330 | C. I. 199:1 | Outstanding brightener for polyester fiber and T/C, T/S, and T/W blends. |

| Name | C.I. Code | Application |
|---|---|---|
| VBL | C. I. 85 | Brightener of cellulose and paper. |
| BC | | Brightener of cellulose and paper. |
| DST | | Whitening agent for cotton fabric. |
| 4BK | | Whitening agent for cotton fabric. |
| BBU | C.I.220 | Whitening agent for cotton fabric cellulose fabric and light colored cellulose fiber. |
| PF | C. I. 135 | Mainly be used in whitening of polyester fiber and plastic, as well in whitening of polyester fabric |
| CBS-127 | C. I. 378 | Whitening agent for PVC and polystyrene series of products and thermoplastics. |
| OB-1 | C. I. 393 | Outstanding whitener of polyester and its flake. Also can be used for polyester fiber and plastics. |
| OB | C. I. 184 | Widely used in whitening of thermoplastics, PVC, PP, PE, PS, ABS, paint, ink and coating. |
| KCB | C. I. 367 | Mainly used for whitening of synthetic fabrics and plastics. Also can be used for coating, natural paint. |
| KCN | | Mainly used for whitening of polyester fiber and plastics. |
| MDAC | C.I.91 | Mainly used for whitening of H-PVC,S-PVC. |
| HPE | C. I. 220 | Brightener of cellulose and paper. |
| CXT | C. I. 71 | Mainly used for whitening of detergent and soap. |
| CBS-X | C. I. 351 | Mainly used for whitening of detergent and soap. |

## 3.13 SOFTENING AGENTS

Softening is carried out when the softness characteristics of a certain fabric must be improved, always carefully considering the composition and properties of the substrate.

Fabric softeners deposit a waxy; lubricate substance on fibres that causes fabrics to feel softer. The softening effect is especially desirable for fabrics with a napped or pile surface that may become harsher after laundering. Towels, washable blankets, diapers, corduroy or other pile fabrics and sweaters are often washed with fabric softeners.

**Benefits of Fabric softening**

- ✓ Makes fabric feel softer
- ✓ Cuts down static electricity
- ✓ Makes ironing easier
- ✓ Improves the performance of durable press finishes

**Types of Fabric softeners**

The softening agents applied are hygroscopic or lubricating agents, which facilitate the fibre sliding within the fabric structure, thus granting easier deformation and creasing of the fabric. In most cases, the duration of the effect is limited since the products applied during the treatment are eliminated by subsequent washing; for this reason they must be applied in the final stage of the treatment. The most common types of softeners are below:

- ✓ Cationic softeners
- ✓ Reactive softeners
- ✓ Emulsion softeners
- ✓ Silicone softeners

**Non-ionic Softeners:**

Non-ionic Softeners are generally ethers and polyglycol esters, oxiethylates products, paraffin's and fats. These softening agents are generally less efficient

than anionic and cationic ones but they withstand the effects of hard waters, acid or basic environment and also in presence of cations and anions, therefore the normal fabric care conditions.

**Anionic Softeners:**

Sulphoricinates, anionic surfactants produced by the condensation of fatty acids. They have good characteristics as lubricating softening agents and give the fabric a full hand; they are unstable in hard water and acid environment. In addition, they must not cause yellowing at condensation temperatures.

**Cationic Surfactants:**

Usually they are quaternary ammonium salts, amino-esters and amino amides; they are recommended for all types of fibre, and can be also applied with exhaustion process in acid environment (pH 4-5). These are the best softening agents and are also called molecular velveting agents because they form bonds with the cationic group on the surface of the fibre generally with negative electric potential. They can give some problem in presence of large anions, and they can cause dye toning, or a reduction in fastness to light values in the presence of direct and reactive dyes; they also have a high polluting charge as waste water (bactericides).

**Silicone-Based Softeners:**

These are generally polysiloxane derivatives of low molecular weight. They are insoluble in water, and therefore must be applied on fabrics after dissolution in organic solvents, or in the form of disperse products. They feature quite good fastness to washing. They create a lubricating and moderately waterproof film on the surface and give fabrics a velvetysilky hand (desirable for velvets, upholstery fabrics and emerised fabrics)

**Reactive Softeners:**

N-methylol derivatives of superior fatty amides or urea compounds replaced with fatty acids. The products have to be cross-linked and provide permanent softness and water repellence.

**Fabric Softening Process:**

To change the hand properties of a fabric, we can apply mechanical, physical, chemical or combined techniques; some of these methods are sueding, raising etc. while some others refers to machines that give different degrees of softness, by means of high-speed rope processing in wet or dry conditions, with the drying stage carried out during the treatment (with or without softeners or enzymes.)

**Check your progress 1**

Is prolonged exposure to heavy metals cause health problems? If yes, explain.

**Notes:** Write your answer in the space given below

---

---

---

---

---

---

---

---

---

## 3.14 LET US SUM UP

Eco specification helps to tackle some of the biggest challenges facing our business and world. Combat climate change, reduce waste, safeguard natural

resources, trade ethics and build a healthier nation. Understanding the nature of chemicals on textiles, their effects and their prescribed limits will help to change consumer demand for eco products.

## 3.15 LESSON END ACTIVITIES

1. Can special attention be paid to the selection of dyes and chemical auxiliaries (which includes keeping products free of hazardous) in manufacturing a garment.

2. The scope of certification allows consumers to recognize the green status of their products. Do you agree with this statement? If yes .support.

**Check your progress 2**

Can you implement essential quality measures to safeguard the business and customers against use of harmful chemicals?

**Notes:** Write your answer in the space given below

---

---

---

---

---

---

---

---

---

## 3.16 REFERENCE

1. Managing quality in apparel industry, Pradeep V Mehta, NIFT Publications

2. An Introduction to quality control for the apparel industry, Mehta P V, Marcel Dekker

3. Physical testing and quality control, Vo123, No. 1/2/3 textile Institute (1993)

4. Textile Testing, John Skinkle, Brooklyn Publication, New York .

5. Textile Testing, P. Angappan & Gopala Krishnan, JK. Publications

## UNIT-IV

## OBJECTIVES

This unit will help you to under stand –

- About Starting and implementing quality control systems
- Quality management through inspection, testing and seven quality tools
- Product Specifications And Analysis Using Analytical Tools

## STRUCTURE

4.1 Introduction

4.2 Starting a Quality Control Program

4.3 Implementation of Quality Systems in Production Line

4.4 Product Specifications and Analysis Using Analytical Tools

4.5 Quality Management through Inspection

4.6 Testing And Seven Quality Tools

4.7 Let Us Sum Up

4.8 Lesson End Activities

4.9 References

## 4.1 STARTING A QUALITY CONTROL PROGRAM

A quality control (QC) program can catch the occasional backward safety wire or misread torque specification. It doesn't need to be elaborate and can apply to any business, even those as small as two mechanics. Assuming that a quality control manual is inevitably somewhere in your future, and that having a QC program will help you stay on the safe side of aviation.

Quality control program help you to maximize the production of goods within the specified tolerances correctly the first time and help to achieve a satisfactory design of the fabric or garment in relation to the level of choice in design, styles, colours, suitability of components and fitness of product for the market.

To start a quality control program in a garment industry your approach should be as follows.

- Itemize the variables that occur in fabric and garment production in order to provide a complete specification.
- Develop a specification in a number of parts or sections to ensure that all design and production staff has a clear idea as to what is needed.
- Establish acceptable working tolerances in relation to all values on the specification.
- Establish fault rate recording systems.
- Improve technical understanding of the product including,
- Fabric geometry and the interrelationship of yarn count, loop length, pick count, relaxation and fabric properties.
- Sewing problems.
- Causes and prevention of seam breakdown.
- The effects of various factors on the apparent shade of goods affecting shade matching.

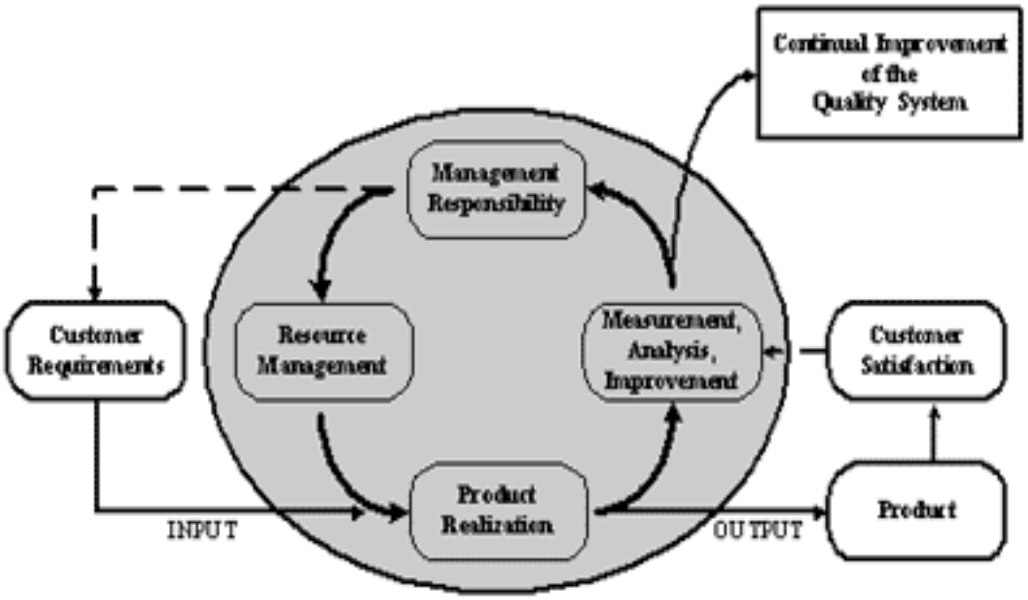
To achieve the overall objective of quality control we shall need to establish, document and maintain a system capable of ensuring that products conform in total to standards, specifications and sealed samples. This will be required at every stage of manufacture. Records must be maintained to give objective evidence that the specified requirements. There are a number of factors on which quality fitness of garment industry is based such as - performance, reliability, durability, visual and perceived quality of the garment. Quality needs to be defined in terms of a particular framework of cost.

## 4.2 IMPLEMENTATION OF QUALITY SYSTEMS IN PRODUCTION LINE

### QUALITY SYSTEM

A Quality System (QS) is the process, organizational structure, procedures, and resources used to control variables to produce a product of consistent quality that meets defined specifications.

**FIGURE : 4.1 QUALITY SYSTEMS**



**Benefits of a Quality System**

- Provides a vehicle for continuous improvement
- Reduces scrap and rework defects
- Increases competitive advantage
- Removes trade barriers and opens new markets
- Increases customer satisfaction
- Improves communication at all levels

Is your company faces following issues?

- Customers now requiring a formal Quality System (e.g., ISO 9000)?
- Lack of standardization in your processes?
- Inconsistent product quality?
- Customer returns, complaints, and audits?

If YES, your company may benefit from Quality Systems Implementation Assistance

**UNDERSTAND AND/OR IMPLEMENT A QUALITY SYSTEM**

Understand your business objectives and your Quality Systems needs. Quality consultants may provide background on standards and specifications to owners and managers to show the advantages of a Quality System. They assist owners and managers in reaching company QS goals with implementation planning and guidance, process development, system auditing and assessment.

**QUALITY SYSTEM GAP ASSESSMENT**

Is your growing business facing the following issues?

- Customers asking you to comply with their standard, or an industry standard for a quality assurance system?
- Customers requiring ISO-9000 registration for continued business?

- Not sure how to interpret a quality assurance standard for your industry?
- No formal quality assurance system in place?
- Planning to export your products to Europe, or other overseas markets?

If YES, you may benefit from a Quality Systems - Gap Assessment

What is Quality System - Gap Assessment?

A gap assessment is an on-site analysis of the current system used to ensure quality products and services, a review of related standard(s), and a report for the company outlining the gaps between the current system and the standard.

What are the benefits of a Quality System - Gap Assessment?

- It provides clear direction on the work needed to comply with a standard.
- It removes the guesswork when interpreting a quality standard.
- It leads to a concise project plan for upgrading a quality system.
- It can be done in just a few days.
- Time savings, especially for company owners and managers.

The above may help your firm to understand the business and the firm's quality system needs. Quality consultants may reveal the gaps between the current system and the standard. They assist owners and managers in determining if an improved quality assurance system is advantageous in reaching company goals by providing insight into quality system elements, registration assistance, and what to expect with upgrading a company quality system. If ISO-9000 or some other quality system standard is appropriate for your company, the experienced staffs can provide individualized training, coaching, and direct implementation assistance.

## 4.3 PRODUCT SPECIFICATIONS AND ANALYSIS USING ANALYTICAL TOOLS

**A Product Specification** is a document that provides critical defining information about a product and can include identification of the manufacturer; a list of rules, bans and standards that apply to the item; design specifications and product images that visually illustrate the product and note distinguishing characteristics. By documenting the product and its features, the specification can be a useful screening tool to identify when a pre-production product differs from one on the store shelf, signaling the possibility of a material or design change, and potentially a non-compliant product. **An analytical tool** is something used to analyze or "take a closer look at" something. It is normally a way to review the effectiveness of something.

### ANALYTICAL TOOL FOR APPAREL

**Identification test:**

- ✓ Fiber analysis
- ✓ Yarn size
- ✓ Fabric count
- ✓ Fabric weight
- ✓ Fabric construction

**Strength and performance tests:**

- ✓ Tensile (woven)
- ✓ Tear(woven)
- ✓ Bursting(knit)
- ✓ Seam strength / stretchablity
- ✓ Pocket strength
- ✓ Snap/zipper strength
- ✓ Stretch and recovery for elastic item

- ✓ Pilling
- ✓ Pile retention (corduroy)

**Colour fastness tests:**

- ✓ Laundering / dry cleaning
- ✓ Chlorine bleach
- ✓ Non-Chlorine bleach
- ✓ Crocking
- ✓ Light
- ✓ Perspiration (lining or skin contact )
- ✓ Ozone and burnt gas fume (indigo &white )

**Label verification:**

- ✓ Country of origin
- ✓ Fiber content
- ✓ Care labeling
- ✓ Registration (RN) number
- ✓ Size
- ✓ Copyright verification
- ✓ Stuffed articles label (Canada)

**Washability:**

- ✓ Dimensional stability
- ✓ Appearance in laundering ( includes self- staining, torque, skew, trim/ seam durability, trim/ garment compatibility, puckering, raspy hand, pill/ fuzz, etc…)

**Other required tests:**

- ✓ Flammability
- ✓ pH(washed items)
- ✓ Azo colorants(European requirements)

**Additional test for technical outer wear / rain wear:**

- ✓ Water repellency
- ✓ Water resistance
- ✓ Coating verification
- ✓ Breathability

**Additional test for infant garment:**

- ✓ Heavy metal/ lead content on surface paints/coating
- ✓ Formaldehyde content
- ✓ Colour fastness to saliva (under 36months)
- ✓ Children safety construction review (includes small parts, sharp objects, drawstrings, etc….)

**Additional test for intimate and sleep wear:**

- ✓ Flammability (children sleep wear )
- ✓ Yarn slippage
- ✓ Colour fastness to perspiration
- ✓ Stress and recovery for elastic band

**Additional test for sweaters:**

- ✓ Garment weight
- ✓ Neck stretch

**Additional tests for swim wear:**

- ✓ Colour fastness to sea water, water, chlorinated pool water

**Additional test for down fill products:**

- ✓ Air permeability
- ✓ Down proof ness
- ✓ Down/feather labeling requirement
- ✓ Fill power
- ✓ Turbidity
- ✓ Oxygen number

**Additional test for wrinkle resistant garment:**

- ✓ Formaldehyde content
- ✓ Flex abrasion
- ✓ Durable press rating

**ANALYTICAL TOOL FOR APPAREL ACCESSORIES**

**General Properties:**

- ✓ Heavy metals( painted surface)
- ✓ Lead content( all surface coating)
- ✓ Nickel leaching (skin contact only)
- ✓ Formaldehyde (zipper, button; children under 3 years)

**Visual testing:**

- ✓ Manufacturing qualities (zipper, snap)

**Strength/durability properties:**

- ✓ Appearance after laundering/ dry cleaning
- ✓ Zipper strength

- ✓ Button and snap strength
- ✓ Resistant to corrosion (metal only)
- ✓ Impact resistant (button)
- ✓ Centre strength (button)
- ✓ Ligne size (button)
- ✓ Thickness (button)

## 4.4 QUALITY MANAGEMENT THROUGH INSPECTION

To obtain an overall picture of where you stand in terms of quality, perform 100% final inspection of all styles for at least two to three weeks and collect information. The preceding list of defects is by no means exhaustive. It is only an example. You may develop your own list.

**TABLE: 4.1 FINAL INSPECTION OF STLYE XYZ**

| S. No | Defects | 1st week | 2nd week | 3rd week | Total | % of Total |
|---|---|---|---|---|---|---|
| 1 | Broken button | 10 | 15 | 5 | 30 | 14.4 |
| 2 | Broken snap | | | | | |
| 3 | Broken stitching | 3 | 4 | 5 | 12 | 5.8 |
| 4 | Defective snaps | | | | | |
| 5 | Different shade within the same garment | 2 | 5 | 4 | 11 | 5.3 |
| 6 | Dropped stitches | | | | | |
| 7 | Exposed notches | | | | | |
| 8 | Exposed raw edges | | | | | |
| 9 | Fabric defects | 15 | 10 | 20 | 45 | 21.6 |
| 10 | Holes | | | | | |
| 11 | Inoperative zipper | | | | | |
| 12 | Loose/hanging threads | 5 | 10 | | 15 | 7.2 |
| 13 | Misaligned buttons and Button | | | | | |

| S. No | Defects | 1st week | 2nd week | 3rd week | Total | % of Total |
|---|---|---|---|---|---|---|
| | holes | | | | | |
| 14 | Missing button | 20 | 5 | | 25 | 12.0 |
| 15 | Needle cuts/chews | | | | | |
| 16 | Open seams | 15 | 10 | 15 | 40 | 19.2 |
| 17 | Pulled / loose yarn | | | | | |
| 18 | Stains | | | | | |
| 19 | Unfinished buttonholes | 10 | 5 | 15 | 30 | 14.4 |
| 20 | Zipper too short | | | | | |
| 21 | Total defects | 80 | 64 | 64 | 208 | |
| 22 | No. of defective samples | 65 | 50 | 45 | 160 | |
| 23 | No. of samples inspected | 500 | 500 | 500 | 1500 | |
| 24 | Percent (%) defective | 13.0 | 10.0 | 9 | 10.7 | |

*A defective sample (garment) can have more than one defect.

Analyze the data collected from 100% inspection such as shown in the Table.4.1. This is an example of how a continuous score of defects can be kept for an easy analysis of data. If a pattern of defects emerges, it makes a solution that much easier because now you know where your problems are. If a pattern does not emerge, it means that you have widespread quality problems.

Please note that each number in the Table indicates a defect. A garment can have more than one defect. Therefore, the number of defects and the number of defective samples is not the same. The data in Table indicate that the biggest problem is related to buttons. Broken and missing buttons (30+25 = 55) make up 26.4% (55/208) of the total defects found in the three week period. Someone should therefore look into this matter and try to find the causes of broken and missing buttons. Perhaps, button quality is such that they break in pressing, may be they are attached so poorly that with the slightest stress they come off. A second

area of concern here is fabric defects as they constituted 21.6% (45/208) of total defects. Fabric defects can further be analyzed and grouped into various categories of defects (such as stains, slubs, missing picks, dropped stitches, etc.) A third area of concern should be open seams, which constituted 19.2% (40/208) of total defects.

The above table also helps you analyze the number of defective garments for the three week period.

The individuals selected for a quality control inspector's job must have a lot of initiative, and be able to work under minimum supervision. They should also be tactful in dealing with people. Quality control inspectors must not be paid on a piece rate basis but should be salaried employees. It is not how much they do but what they do is important.

## 4.5 MANAGING QUALITY THROUGH TESTING

When one mentions testing to a garment manufacturer, usually, the manufacturer envisions a full fledge testing laboratory. However to effectively manage quality of garments, one does not need to have a full fledge testing laboratory. An effective testing program can include only a pair of washer and dryer. It is amazing how much information can be gathered for decision making by only washing and drying an item of clothing. With a washer and dryer, one can find out something about shrinkage, and colourfastness in laundering, durable press qualities, durability of seams, durability of fusible interlining, if trimming and accessories will withstand appropriate washing and drying, compatibility of trimmings with the rest of the garment in terms of shrinkage and colourfastness and shrinkage of zipper tape.

Proper use of the above information will go a long way toward improving the quality of clothing. Also, an agreement can be made with a commercial testing laboratory to suit your testing needs. Even though you may not want to invest in

extensive testing facilities it would be certainly advantageous to have at lease one employee from your quality control department to attend a short course on testing offered by some of the textile and fashion colleges or textile associations.

## 4.6 SEVEN QUALITY TOOLS

These are the most fundamental quality control (QC) tools. They were first emphasized by Kaoru Ishikawa, professor of engineering at Tokyo University and the father of "quality circles."

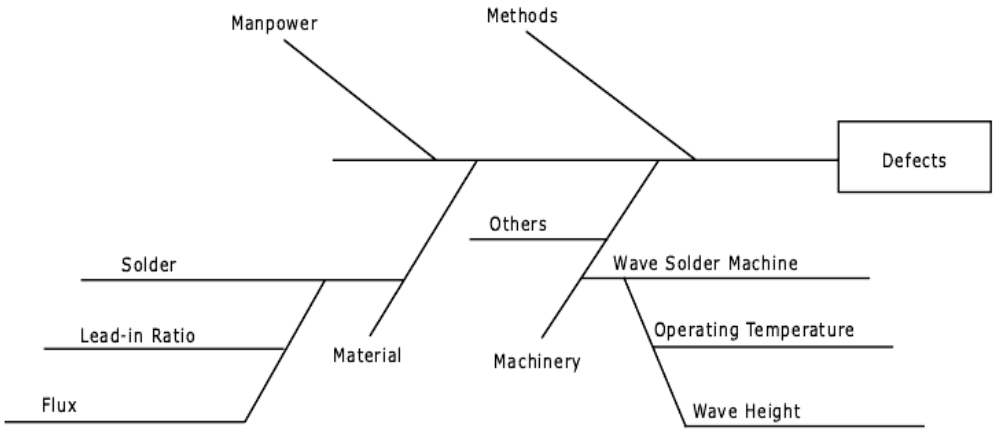
### 4.6.1 CAUSE-AND-EFFECT DIAGRAM OR FISH BONE DIAGRAM:

A Cause-and Effect Diagram is a tool that shows systematic relationship between a result or a symptom or an effect and its possible causes. It is an effective tool to systematically generate ideas about causes for problems and to present these in a structured form. This tool was devised by Dr. Kouro Ishikawa and as mentioned earlier is also known as Ishikawa Diagram. Another name for the tool, as we have seen earlier, is Fish-Bone Diagram due to the shape of the completed structure.

**Fish Bone diagram- procedure**

- ✓ A line is drawn across the middle of a sheet of paper to a box on the right hand side. In that box, the problem statement is written.
- ✓ Major possible categories of cause are distributed along the line.
- ✓ From these, lines are drawn sloping to the left.
- ✓ From these lines, contributing issues for each category are placed.
- ✓ From these, additional lines can be drawn. the final result is a tree with all potential causes identified.

**FIGURE : 4. 2 FISH BONE DIAGRAM**




## 4.6.2 CHECK SHEET

Check sheet is also called "Defect concentration diagram". A check sheet is a structured, prepared form for collecting and analyzing data. This is a generic tool that can be adapted for a wide variety of purposes. This is used to identify symptoms and/or potential cases for a problem. It is a simple checklist that is used to record when something occurs.

**When to Use?**

- When data can be observed and collected repeatedly by the same person or at the same location.
- When collecting data on the frequency or patterns of events, problems, defects, defect location, defect causes, etc.
- When collecting data from a production process

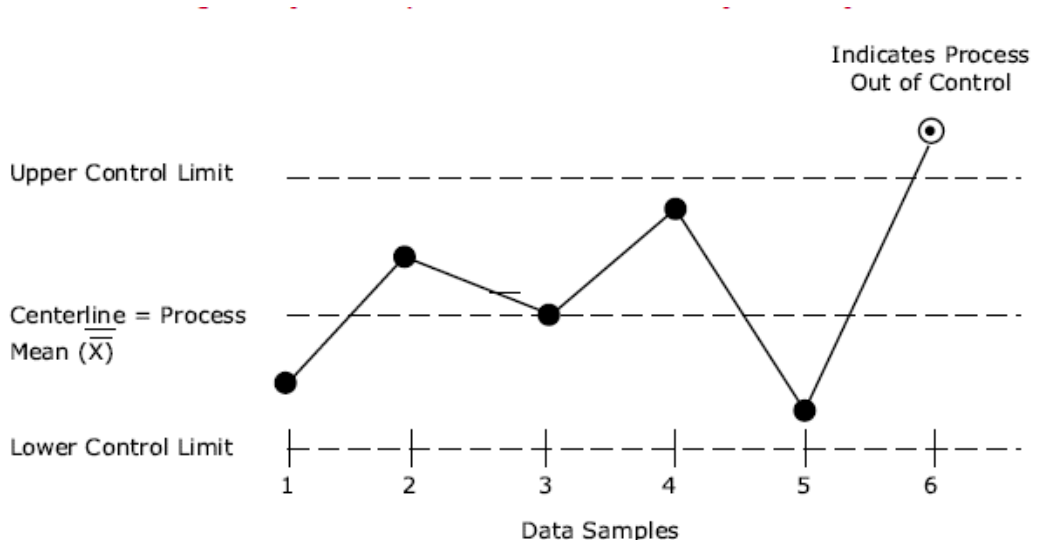
**TABLE: 4.2 CHECK SHEET**

| Defect | Monday | Tuesday | Wednesday | Thursday | Friday | Total |
|---|---|---|---|---|---|---|
| Solder | I | II | | I | | 4 |
| Part | II | | I | II | I | 6 |
| Not-to-Print | III | II | I | III | II | 11 |
| Timing | | I | I | | I | 3 |
| Other | | I | | | | 1 |

## 4.6.3 CONTROL CHARTS

Control charts are a method of Statistical Process Control, SPC. (Control system for production processes). They enable the control of distribution of variation rather than attempting to control each individual variation. Upper and lower control and tolerance limits are calculated for a process and sampled measures are regularly plotted about a central line between the two sets of limits. The plotted line corresponds to the stability/trend of the process. Action can be taken based on trend rather than on individual variation. This prevents over-correction/compensation for random variation, which would lead to many rejects.

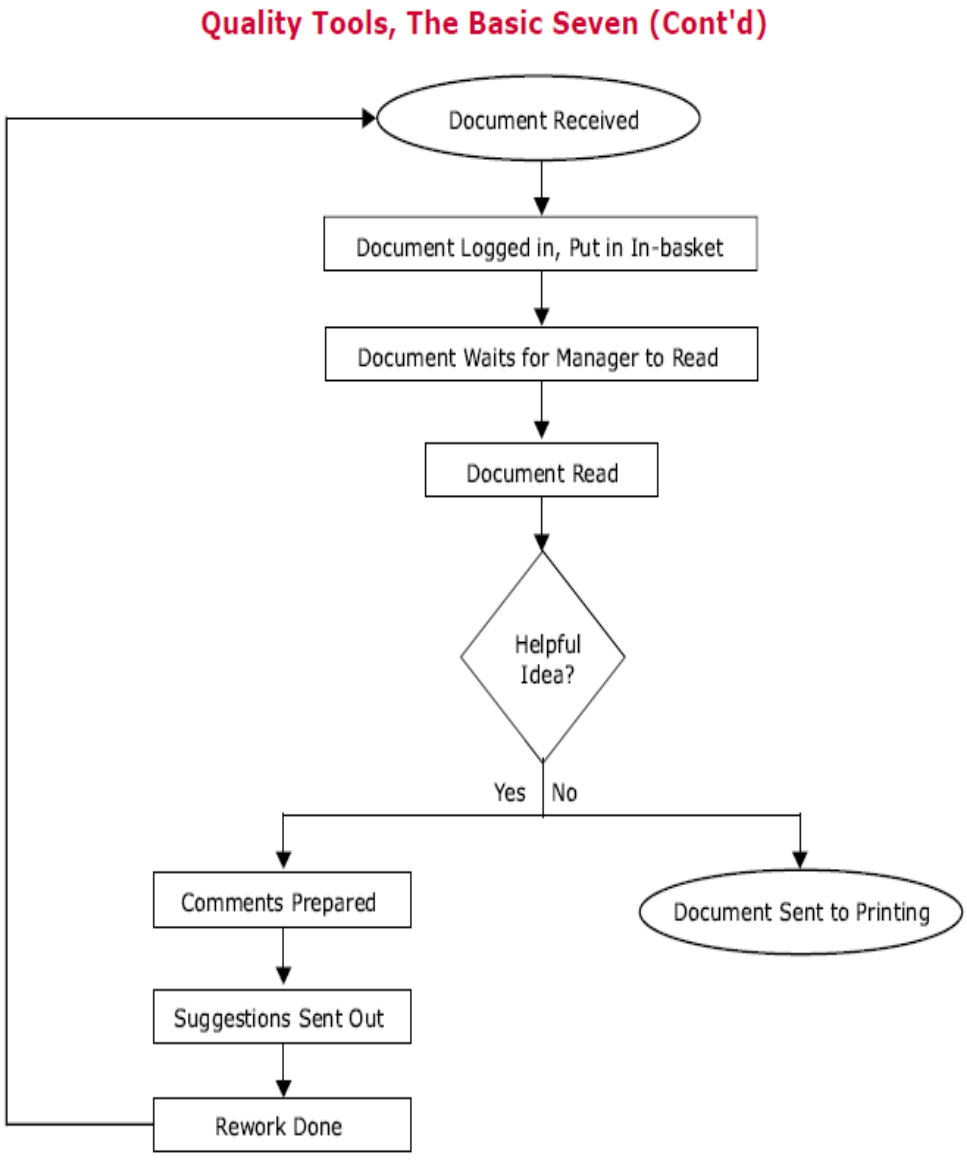
**FIGURE: 4.3 CONTROL CHART**



## 4.6.4 FLOW CHART

Flow chart or run chart is used to understand the process and identify the variables affecting it. Pictures, symbols or text coupled with lines, arrows on lines show direction of flow. You can use this quality control tool to predict potential faults in a process. Apart from being used as a quality control tool, these diagrams are also used in risk analysis.

**FIGURE: 4.4 FLOW CHART SHOWING MANAGEMENT REVIEW**



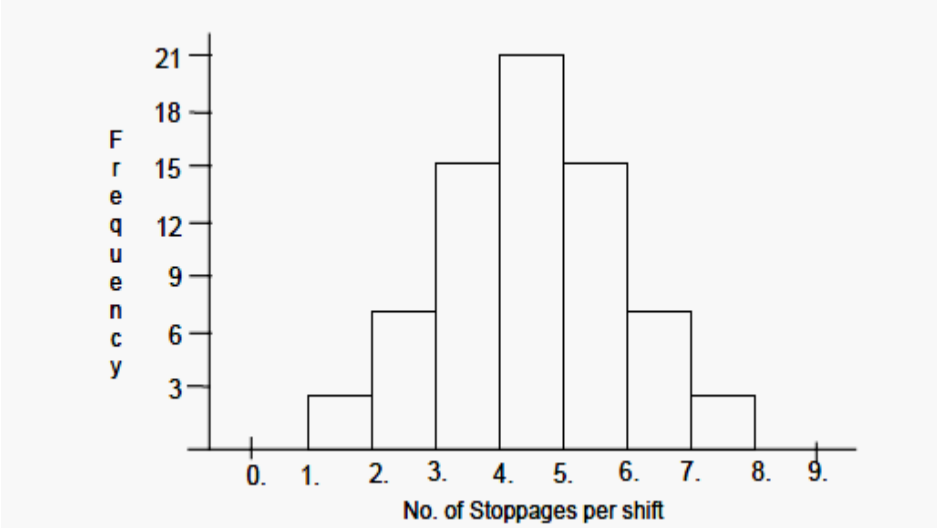
## 4.6.5 HISTOGRAM

Bar chart showing the number of occurrences of some event often derived from the results of a check sheet. It allows a quick prioritisation based on frequency.

Histograms or Frequency Distribution Diagrams are bar charts showing the distribution pattern of observations grouped in convenient class intervals and arranged in order of magnitude. Histograms are useful in studying patterns of distribution and in drawing conclusions about the process based on the pattern.
The Procedure to prepare a Histogram consists of the following steps:

- Collect data (preferably 50 or more observations of an item).
- Arrange all values in an ascending order.
- Divide the entire range of values into a convenient number of groups each representing an equal class interval.
- Note the number of observations or frequency in each group.
- Draw X-axis and Y-axis and decide appropriate scales for the groups on X-axis and the number of observations or the frequency on Y-axis.
- Draw bars representing the frequency for each of the groups.
- Provide a suitable title to the Histogram.
- Study the pattern of distribution and draw conclusion.

**FIGURE: 4.5 HISTOGRAM**



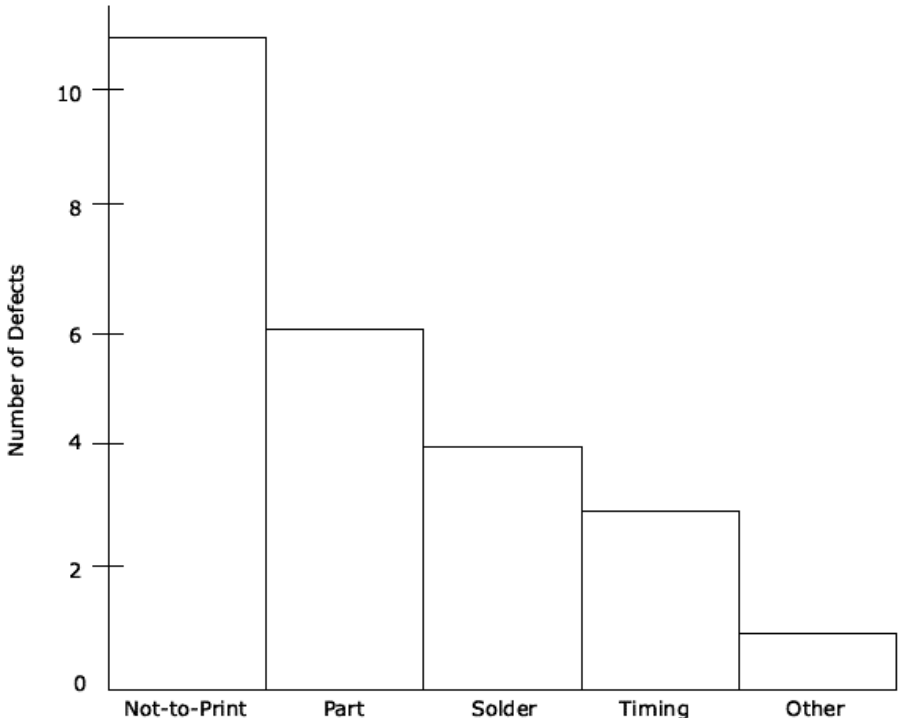

The above table X shows the stoppages against the machine problems and Y the frequency.

### 4.6.6 PARETO CHART/ BAR CHARTS:

A Pareto chart is usually used to identify the principle drivers to a problem.

- A check sheet is used to count how often a particular item occurs usually as a cause to a problem (e.g. missing account number on check leads to miss- filing).
- The items are then charted by the percentage of the occurrences in decreasing order.
- The resulting chart shows which items had the most influence on the problem. This goes along with the 80-20 rule which states that 80% of the problems are attributable to only 20% of the causes.

**FIGURE: 4.6 PARETO CHART**

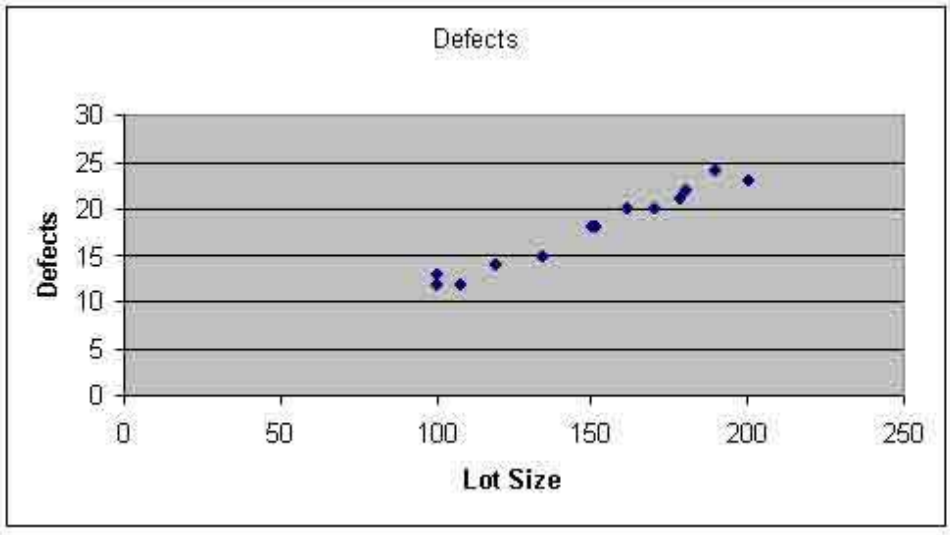



## 4.6.7 SCATTER DIAGRAM

When solving a problem or analyzing a situation one needs to know the relationship between two variables. A relationship may or may not exist between two variables. If a relationship exists, it may be positive or negative; it may be strong or weak and may be simple or complex. A tool to study the relationship between two variables is known as Scatter Diagram. It consists of plotting a series of points representing several observations on a graph in which one variable is on X-axis and the other variable in on Y-axis. If the variables are correlated, the points will fall along a line or curve. The better the correlation, the tighter the points will hug the line.

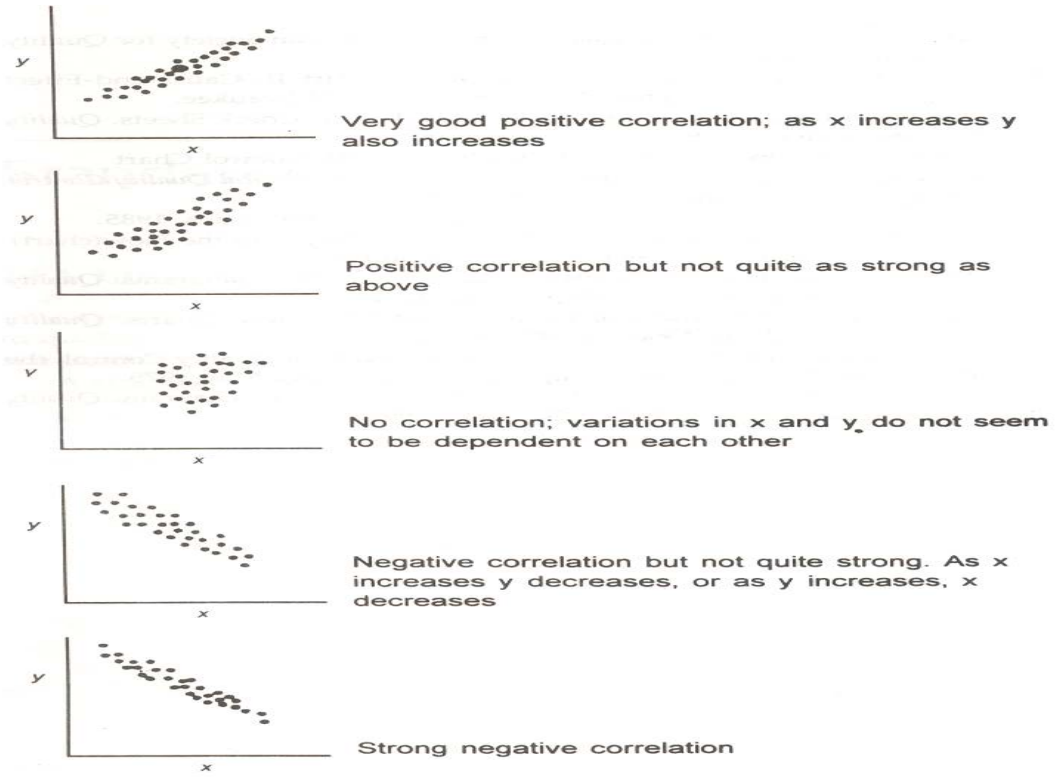
For an example x axis will have the lot size and y axis the amount of quality defects if we are trying to find a relationship between the lot size and quality defects. This will allow you to plot a diagram like below.

**FIGURE: 4. 7 (a) SCATTER DIAGRAM**




This shows a positive correlation between the number of defects and lot size. With the lot size the amount of quality defects also goes up.

**FIGURE: 4.7 (b) TYPES OF SCATTER DIAGRAMS**



## 4.7 LET US SUM UP

Quality control program help you to maximize the production of goods within the specified tolerances correctly the first time and help to achieve a satisfactory design of the fabric or garment in relation to the level of choice in design, styles, colours, suitability of components and fitness of product for the market. Quality consultants may provide background on standards and specifications to owners and managers to show the advantages of a Quality System. Quality management can be done through inspection and testing.

## 4.8 LESSON END ACTIVITIES

"Check sheet is a quality tool and is useful for collecting and analyzing data". Support

## 4.9 REFERENCES

1. Managing quality in apparel industry, Pradeep V Mehta, NIFT Publications.
2. An Introduction to quality control for the apparel industry, Mehta P V, Marcel Dekker.
3. Textile Testing, P. Angappan & Gopala Krishnan, JK. Publications.
4. Quality characterisation of apparel, Dr.Subrata Das, Wood Head Publishing India.
5. Quality management in clothing industries, A.J.Chutter, The Textile Institute.

## UNIT- V

### OBJECTIVES

This unit will help you to under stand -

- About quality cost and customer returns
- Inspection procedures
- Acceptance quality level and quality control

### STRUCTURE

5.1 Introduction

5.2 Quality Costs and Customer Returns

5.3 Inspection Procedures

5.4 AQL and Quality Control

5.5 Let Us Sum Up

5.6 Lesson End Activities

5.7 References

## 5.1 QUALITY COSTS AND CUSTOMER RETURNS

### 5.1.1 QUALITY COSTS

Any activity in business must contribute to overall profits; otherwise, it can not exist, and quality control is no exception. A quality control manager should be able to communicate with senior management in terms of costs, profits, investments, returns, etc and not only in light of production, per cent defective, sampling etc.,

## IMPORTANCE OF QUALITY COSTS

1. Quality cost analysis can be used to identify areas of opportunity for improving quality and reducing costs.

2. Quality costs will give the quality control manager something to talk to senior management about in order to prompt not only corrective actions but also some preventive actions. By showing how much poor quality actually costs, senior management commitment can be enlisted in quality improvement efforts.

3. The performance of a quality control department can be evaluated in financial terms and it can be determined how much cost is involved in achieving a certain level of quality and whether the quality control department is paying its way or not.

4. It will help one budget realistically to achieve a desired quality level.

   Aside from the above reasons, the cost of quality has a direct impact on the profitability of any company.

**Quality affects the company's economics in two basic ways.**

1. **Effect on income:** With superior quality the company can secure a higher share of market, firmer prices, a higher percentage of successful bids, and still other benefits to income. It is this effect on income which makes quality has value.
2. **Effect on cost:** It costs money to build quality to control, to pay for the failures.

The ASQC Quality Cost Committee recommends breaking down quality costs into the following four areas and in the context of garment manufacturing, various quality costs can be divided as follows:

1. **Prevention costs.** Cost of planning various quality functions, cost of evaluating prototype samples (whether testing or wear trials or both) cost of writing specifications, cost of personnel performing such activities.

2. **Appraisal cost.** Inspection costs, testing cost, personnel costs associated with inspection and testing. Testing costs would include cost of the sample destroyed in testing, laboratory supplies, etc.; it can also be cost of using commercial testing laboratory or cost of third party testing.

3. **Internal failure costs.** Repair work costs, scrap costs cost of reinspection, personnel costs associated with these activities.

4. **External failure costs.** Cost of returned merchandise, cost of claims, cost of transportation for the defective merchandise, personnel costs associated with these activities.

The quality costs can be reported as a percentage of some base such as labour cost (direct or indirect) cost of manufacturing, cost of raw materials, sales or profits.

## SETTING STANDARDS OF COST

This can be done by setting a standard or budget for each cost item affected by the action, and by comparing periodically the actual cost with the standard. Differences between standard and actual cost are then notified to appropriate executives who can modify the tactics of the attack as necessary to ensure that the differences are reduced or eliminated.

## ASCERTAINING QUALITY COSTS

When costs are to be ascertained regularly for comparison with standards, however, a number of steps are involved.

- First, it is necessary to decide which costs are to be analyzed on a regular routine basis, which are to be analyzed less frequently, and which will continue to be derived by special cost studies, or sampling cost methods.

- The second step is to decide who is to make each analysis. The preference depends largely upon the source of the information. If the details can be made available from the accounting system the Cost Accountant will logically take on the task. However, if the information is of a technical nature or requires to be extracted from the records of Quality Control or other staff, it may be convenient to have it done by these departments.

- Next a system of cost coding to simplify analysis must be provided. Where a code system is already in use it may require modifying to enable quality control costs to be collected in the most meaningful form. It is important that the causes of faults should be revealed and this may necessitate identification of the machine, operator or process where the loss arose.

- Finally, one must define the procedure to be followed and the responsibilities of all the affected staff.

## CONTROLLING COSTS

The only purpose of reporting costs is to provoke action. Without action the money spent on deriving and reporting data is wasted.

Action is required whenever there is a significant difference between an actual cost and the budget set for it. Action is also required to discover the reason for the difference and to eliminate it. If cost reports are to be effective in provoking this type of action they must be: -

- Presented at suitably short intervals
- Presented quickly following the period they represent

- Presented in simple, direct, intelligible form
- Presented to the people who have the authority and knowledge to act effectively.

It is often effective for reports to be sent both to the person who is expected to take action and also to his immediate superior.

It is important to remember that the actual costs revealed by control reports are the result of joint action by quality control staff and by the design or manufacturing functions. Action to correct undesirable trends may therefore have to be taken by all these groups in co-operation. Action by any one group may well be fruitless.

**REPORTING COSTS**

Effective quality cost control depends upon good cost reporting.

The cost reporting system should:

- Identify the areas of expense, which are being reported
- Show actual expenditure compared with that planned
- Facilitate the comparison of benefits with the price that is being paid for them
- Indicate the causes of excessive costs so that further investigations can be made and corrective action taken.

The data from which the Cost Reports are compiled should be so organized that such further investigations into specific excesses can proceed logically and without the need for too much re-analysis of basic documents.

## 5.1.2 CUSTOMER RETURNS

Since customer satisfaction, or rather customer delight should be the ultimate goal of apparel manufacturers, data on customer returns should be a part of quality information system and such data should be reviewed frequently by the senior management. Customers should be encouraged to contact the manufacturer when garments do not perform well or fit improperly. Instead of viewing a complaining customer as a nuisance, a positive attitude about such complaints should exist and a company should believe that a customer is right until proven otherwise. Remember, as somebody has wisely said, there are no "problem customers", only customers who have problems.

If a customer is not satisfied with a garment and return it for either a refund or replacement, chances are that the customer will continue to buy the same brand, provided the complaint was handled satisfactorily. On the other hand, if a customer does not complain about a defective garment or one that did not perform adequately, chances are that he or she will never buy that brand again.

According to a Washington based research organization caller Technical Assistance Research Programs (TARP) on average across all industries 50"s of all customers with problems, both individual customers and business customers, never complain to anyone. Another 45% complain to a front line retail employee who will either handle or mishandle the complaint. Only 5% will complain to the management. Therefore, for every customer complaint reported to corporate headquarters, one can assume that there are at least 19 other similar complaints that simply were not reported or that were handled by the retailer or front line without being recorded.

Granted, sometimes it is very difficult for customer return information to filter down to the appropriate apparel or fabric manufacturing plants, but the advantage of such information and the analysis of returned garments are

tremendous. For example analysis of returns over the years has led to improved design and color manufacturing controls. A few examples are:

- Increased tensile strength in medium weight denim.
- Use of more appropriate thread sizes and types on major stress seams and seams shown to be abrasion prone.
- Better enforcement of job quality standards at pressing to avoid damage to zipper sliders.
- Improved finishes on hardware to better resist rust and corrosion
- Use of stronger zippers in certain product lines.
- Better enforcement of quality standards on jobs susceptible to latent defects
- Additional inspection at key jobs on a temporary basis.
- Occasional pattern and method changes.

Other benefits from a return program that are at least equally as important are:

- Chance to see the latent defects those that could not be seen at final inspection shrinkage, raw edges from seams improperly fed into folders, bleeding of dyes, seam slippage, etc.,
- Improved standards, additional standards and even new test methods have resulted from problems encountered by our customers, many of them latent type of defects.
- Vendors can learn a great deal about the performance of their products that should lead to more appropriate standards or stricter conformance to existing standards by them.

- Looking at actual field failures is much convincing than statistics alone. Returns can help to persuade those who design and who purchase materials as well as those who enforce standards in apparel plants.

- It is the experience of one of the authors that sometimes even a single customer complaint reveals a significant problem. Also, there have been cases in which apparel manufacturers were greatly thankful and appreciative of the customer return information they received from retailers because such information helped them improve the quality of their products and, of course, the image of those products with it.

- For the long term success of any business, repeat customers are very important. However, customers will return to buy from the same company only if they remain satisfied customers.

## 5.2 INSPECTION PROCEDURES

The purpose of inspection is to make judgment on the disposition of a material to product, whether to accept or reject it. The main objective of inspection is the early detection of defects, feedback of this information to the appropriate people, and determination of the cause, ultimately resulting in the correction of the problem.

Inspection procedure involves incoming material inspection, source inspection, in-process inspection, in-coming goods inspection, vendor inspection and final inspection.

### 5.2.1. INCOMING MATERIAL INSPECTION

The incoming material upon reception is checked.

**CORE INSPECTION MODULES**

- ✓ On-site Random Visual Inspection
- ✓ Control of accessories and components conformity and quality (trims, textile accessories, interlining, embroidery, laces and elastics, etc.)
- ✓ Pick up of samples for In-house or Accredited Laboratories Testing

**BENEFITS**

- Minimizes the negative impact of the inferior components before production starts.
- Ensures timely deliveries and the right quantity being received to factory before production starts.
- Ensures the quality and conformity of accessories and components match with your expectations and with elements approved at development stage.

### 5.2.2 SOURCE INSPECTION

Inspection at the supplier's place including materials, components, products or documents.

### 5.2.3 IN-PROCESS INSPECTION

Visual inspection of all parts, components and materials during the production process.

For example, in a sewing floor, the inspection process is further divided as:

A. In- Line Inspection

B. End-Line Inspection

C. Quality Audits

## A. IN-LINE INSPECTION

In-Line Inspection means the inspection of parts before they are assembled into a complete product.

**Purpose of inline inspection**:

- In-line inspection should be conducted at least once a shipment.

The checking criteria may be as below:

- To check the fabric quality in terms of colour shade, hand feel and printed patterns against the standards.
- To check the measurements of semi-products against the size specification. When checking this, fabric shrinkage, stretch ability and other factors that may affect the measurement during manufacturing process must be taken into consideration.

**TABLE: 5.1 PROCEDURES FOR IN-PROCESS CHECKING**

| Step | Task | Responsibility | Reference |
|---|---|---|---|
| I | Determine the no. of checkpoints to be installed within the line and include them as normal workstations. | Supervisor | Operation Sequence |
| II | Check the finished garment for workmanship (stitching) and measurement quality at each checkpoint. | Checker | Quality specification sheet |
| III | Pass the garment if no defects. | Checker | |
| IV | Reject the garment if defects are found. | Checker | |
| V | Mark the defects found on the garment with clearly visible stickers. Record the defects. | Checker | 100% Inspection Record |

| Step | Task | Responsibility | Reference |
|---|---|---|---|
| VI | Give the repairs to the concerned section supervisor to complete. Enter the defects onto the repair list. Also enter the bundle number and the time when it was collected. | Operator | Repair record sheet. |
| VII | Return the repairs to the operator. | Supervisor | |
| VIII | Check the repair number on the repair list. Fill out the time when the pieces were returned. | Operator | Repair list |
| IX | Recheck the garment. | Original Checker | Quality specification sheet |
| X | Select or reject as in step II or III. | Original Checker | |

## B. END-LINE INSPECTION

Inspection done at the end of the line after the whole garment is completed.End-Line Inspection means inspecting finished goods from the customer point of view. End-Line Inspection may occur before or after garments are packed in poly bags & boxes. If it is done after garments are packed, then proper size & style markings on the package can also be checked.

## C. FINAL INSPECTION

- ✓ It is the last inspection done before the buyer inspection
- ✓ All the buyer specifications are checked for-

1. Form Fit checking

2. Sewing- needle damages, sewing defects, assembly defects, quality of seam, placement of labels, cleanliness , correct trims
3. Measurements
4. Final hand feel and look
5. Packing and packaging

Final inspection can be conducted under the following conditions:

- ✓ The quantity in carton boxes must be at least up to 80% of the total shipped quantity.
- ✓ The sewing or assembly process must be finished for the balance quantity (20% of the total shipped quantity)

**TABLE: 5.2 PROCEDURES FOR FINAL INSPECTION**

| Step | Task | Responsibility | Reference |
|---|---|---|---|
| I | Lay the garment flat on the table. Check the finished garment for overall stitch quality and material defects. | Quality Checker | Quality specification sheet |
| II | Check each part of the garment in a sequence. Flatten the seams. | Quality Checker | |
| III | Turn the garment inside out and check for the stitching inside. Send for repair if defects are found. | Quality Checker | |
| IV | Mark the defects found on the garment with clearly visible stickers. | Quality Checker | Record the defects |

| Step | Task | Responsibility | Reference |
|---|---|---|---|
| V | Check the garment for measurements, which should be within the tolerance limit. | Quality Checker | Tolerance sheet. |
| VI | Give the bundle to the concerned section supervisor to carry out repairs. Enter the defects onto the repair list. Also enter the bundle number and the time when it was collected. | Operator | Repair list |
| VII | Return the repair bundles to the operator. | Supervisor | |
| VIII | Return the repair bundles to the original checker. Fill out the time when the pieces were returned. | Operator | Repair list |
| IX | Recheck the bundle. | Quality Checker | Quality specification sheet |
| X | Select or reject as in step II or III. | Quality Checker | |

### 5.2.4 IN-COMING GOODS INSPECTION

Inspection done for goods outsourced or components and accessories are inspected upon arrival at the finished garment manufacturers.

### 5.2.5 VENDOR INSPECTION

Inspection done to check the vendor's facility and operations

### 5.2.6 FINAL INSPECTION

Final inspection is done to ensure whether the products meet the required standards and specifications. Final inspection may occur before or after garments are packed in poly bags and boxes. Final inspection consists of inspecting finished garments from the consumers point of view i.e. size measurement, form fitting and live modeling if necessary.

**Check your progress 1**

Why it is important to know the cost of quality

**Notes:** Write your answer in the space given below

---

---

---

---

---

---

---

---

---

## 5.3 AQL AND QUALITY CONTROL

### Brief History of AQL and Acceptance sampling

Acceptance sampling is an important field of statistical quality control that was popularized by Dodge and Roming and originally applied by the U.S. military for the testing of bullets during World War II. If every bullet was tested in advance, no bullets would be left to ship. If, on the other hand, none were tested, malfunctions might occur in the field of battle, with potentially disastrous results. Acceptance sampling plans help in distinguishing between the acceptable and the

unacceptable lots. The basic assumption here is if the proportionate sample is randomly drawn from a lot, the sample would represent the quality level of the lot and based on this the acceptance decision can be made. Acceptance Sampling is the middle of the road approach between 100% inspection and no inspection.

**Acceptable quality level**

An acceptable quality level is a test and/or inspection standard that prescribes the range of the number of defective components that is considered acceptable when random sampling those components during an inspection.

The defects found during an electronic or electrical test, or during a physical (mechanical) inspection, are sometimes classified into three levels: critical, major and minor. Critical defects are those that render the product unsafe or hazardous for the end user or that contravenes mandatory regulations. Major defects can result in the product's failure, reducing its marketability, usability or salability. Lastly, minor defects do not affect the product's marketability or usability, but represent workmanship defects that make the product fall short of defined quality standards. Different companies maintain different interpretations of each defect type. In order to avoid argument, buyers and sellers agree on an AQL standard, chosen according to the level of risk each party assumes, which they use as a reference during pre-shipment inspection.

**Application of 'AQL'**

'AQL' for 'Acceptance Quality Limit', and is defined as the "quality level that is the worst tolerable" (ISO 2859 standard).

For example: "I want no more than 1.5% defective items in the whole order quantity" means the AQL is 1.5%.

In practice, three types of defects are distinguished. For most consumer goods, the limits are:

- ✓ 0% for critical defects (totally unacceptable: a user might get harmed, or regulations are not respected).
- ✓ 2.5% for major defects (these products would usually not be considered acceptable by the end user).
- ✓ 4.0% for minor defects (there is some departure from specifications, but most users would not mind it).

These proportions vary in function of the product and its market.

**Get familiar with the AQL tables**

Before using the AQL tables, you should decide on three parameters:

- ✓ The 'lot size'. If you ordered different products, the quantity of each product is a lot size, and separate inspections should be carried out for each lot. If you ordered only one product, the lot size is your total order quantity.
- ✓ The inspection level. Different inspection levels will command different number of samples to inspect. In this article, we will stick to the so-called "level II", under "normal severity".
- ✓ The AQL level appropriate for your market. If your customers accept very few defects, you might want to set a lower AQL for both major and minor defects.

There are basically two tables. The first one tells you which 'code letter' to use. Then, the code letter will give you the sample size and the maximum numbers of defects that can be accepted.

**First table: sample size code letters**

## TABLE: 5.3 SAMPLE SIZE CODE LETTERS

| Lot size (Number of ordered products) | | | General inspection levels | | |
|---|---|---|---|---|---|
| | | | I | II | III |
| 2 | to | 8 | A | A | B |
| 9 | to | 15 | A | B | C |
| 16 | to | 25 | B | C | D |
| 26 | to | 50 | C | D | E |
| 51 | to | 90 | C | E | F |
| 91 | to | 150 | D | F | G |
| 151 | to | 280 | E | G | H |
| 281 | to | 500 | F | H | J |
| 501 | to | 1,200 | G | J | K |
| 1,201 | to | 3,200 | H | K | L |
| 3,201 | to | 10,000 | J | L | M |
| 10,001 | to | 35,000 | K | M | N |
| 35,001 | to | 150,000 | L | N | P |
| 150,001 | to | 500,000 | M | P | Q |
| 500,001 | and over | | N | Q | R |

How to read this table?

If you follow my example, I assume your 'lot size' is comprised between 3,201pcs and 10,000pcs, and that your inspection level is 'II'. Consequently, the code letter is "L".

**Second table: single sampling plans for level II inspection (normal severity)**

## TABLE: 5.3 SINGLE SAMPLING PLANS FOR LEVEL II INSPECTION (NORMAL SEVERITY)

| Code letter | Sample size | | | | | |
|---|---|---|---|---|---|---|
| | | 1.0 | 1.5 | 2.5 | 4.0 | 6.5 |
| A | 2 | ≤ 0 | ≤ 0 | ≤ 0 | ≤ 0 | ≤ 0 |
| B | 3 | ≤ 0 | ≤ 0 | ≤ 0 | ≤ 0 | ≤ 0 |
| C | 5 | ≤ 0 | ≤ 0 | ≤ 0 | ≤ 0 | ≤ 1 |
| D | 8 | ≤ 0 | ≤ 0 | ≤ 0 | ≤ 1 | ≤ 1 |
| E | 13 | ≤ 0 | ≤ 0 | ≤ 1 | ≤ 1 | ≤ 2 |
| F | 20 | ≤ 0 | ≤ 1 | ≤ 1 | ≤ 2 | ≤ 3 |
| G | 32 | ≤ 1 | ≤ 1 | ≤ 2 | ≤ 3 | ≤ 5 |
| H | 50 | ≤ 1 | ≤ 2 | ≤ 3 | ≤ 5 | ≤ 7 |
| J | 80 | ≤ 2 | ≤ 3 | ≤ 5 | ≤ 7 | ≤ 10 |
| K | 125 | ≤ 3 | ≤ 5 | ≤ 7 | ≤ 10 | ≤ 14 |
| L | 200 | ≤ 5 | ≤ 7 | ≤ 10 | ≤ 14 | ≤ 21 |
| M | 315 | ≤ 7 | ≤ 10 | ≤ 14 | ≤ 21 | ≤ 21 |
| N | 500 | ≤ 10 | ≤ 14 | ≤ 21 | ≤ 21 | ≤ 21 |
| P | 800 | ≤ 14 | ≤ 21 | ≤ 21 | ≤ 21 | ≤ 21 |
| Q | 1,250 | ≤ 21 | ≤ 21 | ≤ 21 | ≤ 21 | ≤ 21 |
| R | 2,000 | ≤ 21 | ≤ 21 | ≤ 21 | ≤ 21 | ≤ 21 |

How to read this table?

Your code letter is “L”, so you will have to draw 200pcs randomly from the total lot size.

Besides, I assume you have set your AQL at 2.5% for major defects and 4.0% for minor defects. Therefore, here are the limits: the products are accepted if NO MORE than 10 major defects AND NO MORE than 14 minor defects are found.

For example, if you find 15 major defects and 12 minor defects, the products are refused. If you find 3 major defects and 7 minor defects, they are accepted.

## 5.4 LET US SUM UP

Quality cost analysis can be used to identify areas of opportunity for improving quality and reducing costs. Inspection in apparel industry is to make judgment on the disposition of a material to product, whether to accept or reject it. And acceptable quality level is a test and/or inspection standard that prescribes the range of the number of defective components that is considered acceptable when random sampling those components during an inspection.

## 5.5 LESSON END ACTIVITIES

Do inspection procedures ensure quality? If yes support.

## 5.6 REFERENCES

1. Managing quality in apparel industry, Pradeep V Mehta, NIFT Publications