LOOMS WEAVE GLOOM
Published by

Society for Participatory Research in Asia
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First published by PRIA in Dec. 1997

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Cover Design : Dinesh Sharma

Typeset in 11 on 13.5 pt Southern by S.M. Graphics
Printed by S.M. Graphics, Sham Nagar, New Delhi

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Contents

Preface

1. The Textile Industry: Indian Scenario 7

2. Fibre to Fabric: Process 10
   a) Types of Fibres 10
   b) Manufacturing Process 12
   c) Finishing Process 20

3. Health Hazards 27
   a) Dust Hazards 27
   b) Chemical Hazards 32
   c) Physical Hazards 36
   d) Other Hazards 40

4. Control of Hazards 45

5. Annexure 56
Preface

It is an irony that those who facilitate the availability of one of our basic needs that is clothing, are in the most miserable condition. It is unbelievable but true. Although textile industry is one of the oldest organised sector in India but it went through a recession phase in the past few decades. This has made workers vulnerable to exploitation of various kinds. One of it is exposure to health hazards. Even now when this industry is reviving, no stress is given to address the issue of occupational health hazards.

For more than a decade PRIA and its partner organisations have been active among the textile workers and this book is an outcome of the long standing demands. In this book we have tried to trace down the journey of fibers to finished cloth and its associated hazards. This book is an attempt to provide a comprehensive information about the textile industry. The latest information of this field along with some of the actual data information from PRIA and its partners have been used.

We hope that this book will be a humble contribution of PRIA to the world-wide struggle of textile workers for a safe and healthy workplace. I would like to recognise the hard work put in by Sumedha Sharma and the valuable feedback provided by Vijay Kanhere, Sanjeev Pandita, Rukmini Bagchee, Saumy Devasia and Dinesh Sharma.

PRIA dedicates this book to the victims of the inadequately planned and mismanaged textile industries world-wide.

Harsh Jaitli
December 1997
Introduction

The Textile Industry: Indian Scenario

The textile industry is one of the pioneers in the country’s industrial development. It plays a pivotal role in the Indian economy by fetching a large amount of foreign currency through its exports. The textile industry is mainly composed of three sectors which are, the mill sector, powerloom sector and the handloom sector. The industry has witnessed a phenomenal growth during the last four decades. Textile exports presently account for nearly one-third of the country’s total earnings and are the single largest earner of foreign exchange. The industry is growing every year and expanding its export horizon. Some of the achievements of the textile industry during the last financial year (1995-96) include export of textiles (excluding Jute and Handicrafts) amounting to approximately US$ 9022 million (equivalent to Rs. 29,999 Cr.), constituting an increase of 5.8% in dollar terms and 12.1% in terms of rupees over the achievement of the previous year. The export of jute goods during April’ 95 to January’ 96 stood at Rs. 467.26 crores as compared to Rs. 351.29 crore during the corresponding period of the previous year. The woollen industry fetched Rs. 985.43 crores through its exports.¹

The industry employs a large number of workers in different capacities. Cotton/man-made fibre textile mill industry is the single largest organised industry in the country employing 10 lakh workers in about 1475 mills all over the country. Out of these 1475 cotton/man-made fibre textile mills, 1201 are spinning mills and 274 are composite mills. Besides the

¹ Source: Annual Report, 1995-96, Ministry of Textiles, Government of India

Looms Weave Gloom
mills directly involved in the production of textile, a large number of ancillary industries are also dependent on this sector such as manufacturing units of machineries, accessories, and chemicals. It is interesting to see the growth pattern of textile mill from its inception in 1854 when the first mill was started in Bombay. From then on, the textile industry grew slowly, but steadily. By 1947, there were about 423 mills in the country and now after five decades, this sector has shown a phenomenal growth of 71% by expanding to 1475 mills.

The Silk sector of the country is the single largest producer of silk in the world. Sericulture is an important labour-intensive and agro-based cottage industry providing gainful occupation to about six million persons in the rural and semi-urban areas of India. The employment in the Silk mills during 1995-96 is anticipated to be 61 lakh persons.

The woollen industry in the country is small in size and widely scattered. It is basically located in the states of Punjab, Haryana, Rajasthan, Uttar Pradesh, Maharashtra and Gujarat. It employs approximately 12 lakh workers in 658 units.

The textile industry is very complex. The journey from fibre to a fabric begins in agriculture with fibre production of cotton, flax, and other fibrous plants, in husbandry of sheep, other animals, and silkworms, in mining of metals and minerals and in chemical research and production of synthetics. These fibres are processed into yarns and/or fabrics. The yarns are made into fabrics for industrial and consumer use by various means, such as weaving and knitting. The fabrics are converted into finished cloth, which provide particular appearances and performances. These fabrics are made into end-use products, including apparel, home furnishings, and also find various industrial applications. These products are then merchandised and sold. Every one of these aspects of the textile industry is a field in itself, and
there is an inter-dependency with multiplying effects on other industries.

The industry being vast and complex, involves a series of steps which are accompanied by health hazards to the workers involved in them. Each step has health and safety risks which frequently, are distinct and unique to that step of the process. This booklet aims at understanding the processes in textile manufacturing and their hazards. Through the following sections, we will try to understand the complex process of textile manufacturing in the mill sector, the various steps involved and the health hazards involved in this industry. An attempt is made to identify the hazards involved in each step, understand the effects posed to the workers, and define the measures to be taken to help eliminate these hazards.

This sector, which is the backbone of the Indian economy, unfortunately has not devoted adequate attention to the workers employed, who are the main actors in the production process. The government prides itself in the huge amount of currency they get through the textile exports. The industry is expanding rapidly with new technologies and innovations seeping in at a fast pace. A huge amount of revenue is spent on research and development in this sector, while hardly any consideration is given to the workers who work in a hazardous environment and suffer from various diseases related to their work. The apathy of the government towards this issue shows in its plans where there is no amount allocated to research on the people who work in these hazardous industries.
Fibre to Fabric: Process

The journey from fibre to fabric involves a series of steps. Each type of fabric involves different processes, though certain steps remain the same for all. The field of textiles is a huge subject in itself, which is developing at a rapid pace with new technologies and innovations coming up. This section briefly touches upon each field of textile processing, trying to give the reader an overview of the whole process of fabric manufacturing.

Before going into the different processes of manufacturing, it is important to know the different types of existing fabrics.

Types of Fibres

The fibres can broadly be categorised into natural fibres and man-made fibres.

Natural Fibres: They can further be classified under vegetable fibres, animal fibres and mineral fibres.

- Vegetable Fibres: Cotton and linen are the main fibres which fall under this category. The cotton fibre grows in the seed-pod, or boll, of the cotton plant. Cotton yarn is used for all types of apparel and home furnishings. The linen fibre is obtained from the stalk of the flax plant. The fibre is more brittle and less flexible than cotton. It is used for apparel, home furnishings and upholstery.

- Animal Fibres: Wool and silk are the main fibres under this category. Wool fibre grows from the skin of sheep. It is a relatively coarse fibre. Silk fibre is a fine continuous strand unwound from the cocoon of a moth caterpillar known as the silkworm. The fibre is relatively lustrous, smooth, lightweight, strong and elastic.
- **Mineral Fibres:** Asbestos is one of the mineral fibres used in the manufacture of fire fighting suits and fire-resistant fabrics. Asbestos is a natural fibre obtained from varieties of rock. Asbestos is acid-proof, rust-proof, and flame-proof. Consequently it is used for materials requiring these characteristics.

**Man-made Fibres:** Some of the commonly used man-made fibres are as follows:

- **Cellulosic Fibres:** These fibres are derived from the cellulose of the cell walls of short cotton fibres or from pine wood. The cellulose is converted by chemical treatment and transformed into fibre form. Rayon, acetate and triacetate are the three forms of cellulosic fibre.

- **Noncellulosic Polymer Fibres:** This group of fibres is distinguished by being synthesized or created from various elements into large molecules which are called linear polymers, because they are connected in a link-like fashion. The fibres in this category are nylon, aramide, polyester, acrylic, spandex etc.

- **Protein Fibres:** The protein from products like corn and milk are processed chemically and converted into fibre. These fibres have not been commercially successful.

- **Rubber Fibres:** Rubber fibre is a manufactured fibre in which the fibre-forming substance is comprised of natural or synthetic rubber. They are used to make certain elastic fabrics.

- **Metallic Fibres:** Metallic fibre is a manufactured fibre composed of metal, plastic-coated metal, metal-coated plastic, or a core completely covered by metal. Used as a decorative yarn for various apparel and home furnishings.
• **Mineral Fibres:** Various minerals are manufactured into glass, ceramic, and graphite fibres. They are used for home furnishings, industrial applications, aerospace applications etc.

**Manufacturing Process**

The manufacturing process of different fabrics involves a series of steps unique for that particular fabric. Though some steps broadly remain the same for all fabrics, the finer points of the process may differ as each type of fabric has its own way of handling and processing. This section briefly touches upon three main types of fabric processing, namely cotton, wool and silk.

**Cotton**

**Fibres to Yarns**

The journey from fibre to yarn starts from the picking of cotton from plants. The cotton picked from the plants takes the shape of yarn which is woven to give the shape of a cloth which is worn by us. The first stage of transforming cotton into yarn undergoes the process of carding, combing, drafting, twisting and winding.

• **Blending, Opening and Ginning:** After the cotton has been picked, it is run through the cotton gin to remove the seeds from the fiber. This process is called ginning. The word 'gin' is short for cotton engine. The cotton arrives at

12

*Looms Weave Gloom*
the mill in large bales. The compressed mass of raw fibre must be removed from the bales, blended, opened and cleaned. Blending is necessary to obtain uniformity of fibre; opening is necessary in order to loosen hard lumps of fibre and disentangle them; cleaning is required to remove trash, such as dirt, leaves, and seeds. After these processes, the cotton is sent to the cardroom for removing remaining impurities.

- **Carding:** The fibre is disentangled and straightened through carding machines. The straightening process puts
the fibres into a somewhat parallel length-wise alignment. This is necessary for all staple fibres, otherwise it would be impossible to produce fine yarns from the tangled mass.

The cotton is passed through a beater and drawn on a rapidly revolving cylinder covered with very fine hooks and wire brushes. A moving belt of wire brushes slowly moves concentrically above this cylinder. As the cylinder rotates, the cotton is pulled by the cylinder through the small gap under the brushes; the teasing action removes the remaining trash, disentangles the fibres, and arranges them in a relatively parallel manner in the form of a thin web. The blanket of cotton is drawn out into thin fleece and then into the form of a soft rope called Sliver.

- **Combing:** The Sliver is put through an additional straightening process, called combing. In this operation, fine-toothed combs continue straightening the fibres until they are arranged with such a
high degree of parallelism that the short fibres are combed out and separated from the longer fibres. The combing process forms a Sliver of the longest fibres, which, in turn, produces a smoother and more even yarn. This operation eliminates as much as 25 percent of the original Sliver.

- **Drawing**: The cotton Sliver is transferred to the drawing frames. Six to eight threads are joined together to make one strand. The combining of several Slivers for the drawing or drafting process eliminates irregularities that would cause too much variation if Slivers were put through singly. The strands are passed on to spindles, where it is given its first twist and is wound on bobbins.

- **Roving**: These bobbins are placed on the roving frame, where further drawing out and twisting take place until the cotton stock is
about a diameter of a pencil lead. Roving is the final product of the several drawing out operations.

- **Spinning**: The roving, on bobbins, is placed in the spinning frame, where it passes through several sets of rollers running at successive speeds and is finally drawn out to yarn of the desired size. Spinning machines are of two kinds: ring frame and mule frame. The ring frame is a faster process, but produces a relatively coarse yarn. For very fine yarns, the mule frame is required because of its slow, intermittent operation. The ring frame is generally used for mass production. The ring spinning frame completes the manufacture of yarn by drawing out the roving, inserting twist and winding the yarn on bobbins.

**Yarn to Fabric**

- **Weaving**: A major method for fabric construction is weaving. In the weaving operation, the lengthwise yarns, which run from the back to the front of the loom, form the basic structure of the fabric and are called the warp. The crosswise yarns are filling, also referred as weft or woof.
The filling yarns undergo less strain in the weaving process. In preparing them for weaving, it is necessary to spin them to the desired size and give them the amount of twist required for the type of fabric for which they will be used.

Yarns intended for the warp must pass through operations known as spooling, warping and slashing to prepare them to withstand the strain of the weaving process. In spooling, the yarn is wound on larger spools, or cones, which are placed on a rack called the creel. From the creel, the yarns are wound on a warp beam, which is similar to a huge spool. An interrupted length of hundreds of warp yarn results, all lying parallel to one another. These yarns are unwound to be put through a slashing, or sizing bath. The slasher machine covers every yarn with a coating to prevent chaffing or breaking during the weaving process. The sizing used is either starch based or a synthetic substance, such as polyvinyl alcohol or a water-soluble acrylic polymer, depending upon the fibre content of the warp yarns and the kind of loom to be used. The sized yarns are then wound on a final warp beam and are ready for the loom. Weaving transforms the yarn into a fabric.
Silk

• **Sericulture:** The silk fibre is a very fine strand of fibre that is produced by silkworm to encase themselves in the form of cocoons. The cultivation of cocoons for acquiring the silk fibre is known as sericulture. The process starts soon after the eggs of silkmoth are laid. Each healthy egg hatches into what is called an ant. It is a larva about 3mm in length. The larva requires careful nurturing in a controlled atmosphere for approximately twenty to thirty-two days. During this period, it is fed 5 times a day on chopped mulberry leaves. After four changes of skin, or moltings, the worm reaches full growth in the form of a smooth greyish-white caterpillar about 9 cm long. The silkworm begins to secrete a protein fibre; in three days the cocoon is completed. The cocoons are then delivered to the factory where the silk is unwound from the cocoons and the strands are collected.

• **Reeling:** The process includes putting the cocoons through hot and cold immersions to permit the unwinding of the filament as one continuous thread. The process of unwinding the cocoon is called reeling. As the fibre of a single cocoon is too fine for commercial use, three to ten strands are usually reeled at a time to produce the desired diameter of raw silk thread. The cocoons float in water as the fibres are rapidly wound on wheels or drums. The diameter of the silk fibre is so fine, that an estimated 3000 cocoons are required to make 1 metre of silk fabric.

• **Throwing:** Reeled silk is transformed into silk yarn by a process known as throwing. Silk throwing is analogous to the spinning process that manufactures cotton, linen or wool fibres into yarn. Unlike those fibres, the manufacture of silk yarn does not include the processes for producing a continuous yarn by carding, combing, and drawing out. The raw silk yarns are sorted according to size, colour and length.
or quantity and then soaked in warm water with soap or oil. After a process of mechanical drying, the fibres are placed on light reels from which the silk is wound on bobbins.

**Wool**

- **Sorting and Grading:** The wool which reaches the mill contains different grades, or types of wool which need to be graded and segregated according to the length, diameter and quality of the fibre. As many as twenty separate grades of wool can be obtained from one fleece.

- **Scouring:** The raw wool contains natural oil of the sheep which needs to be removed before further processing. This step involves thorough washing of the raw wool in an alkaline solution. This process is known as scouring. The scouring machines contain warm water, soap, and a mild solution of soda ash or other alkali. The machines are equipped with automatic tools which stir the wool and the rollers between the vats squeeze out the water. If the raw wool is not sufficiently clear of vegetable substance after scouring, it is put through the carbonizing bath of dilute sulfuric acid or hydrochloric acid to burn out the foreign matter.

- **Oiling:** The washed wool becomes unmanageable after scouring. Therefore the fibre is usually treated with various oils, including animal, vegetable, and mineral, or a blend of these to keep it from becoming brittle and to lubricate it for the spinning operation.

- **Carding:** In the carding operation, the wool fibres are passed between rollers covered with thousands of wire teeth. As the wool fibres are brushed and disentangled by these wires, they tend to lie parallel, which makes the woollen yarn smooth. After this process, the woollen slivers go directly to the spinning operation.
- **Spinning**: In the spinning operation, the wool is drawn out and twisted into yarn. Woollen yarns are chiefly spun on the mule spinning machine.

- **Warping**: The yarn that leaves the spinning frame is not of sufficient length to serve as warp yarn on the loom. It is first wound on bobbins or spools and placed on a large rack or frame called a creel. Then they are immersed in a solution of starch, gum, or similar compound to make them smooth and strong for weaving.

- **Weaving**: The weaving process for wool resembles the process described for cotton. The fuzzy woollen yarns obtained in the carding process are made into woollen fabrics through this process.

**Finishing Process of Fabric**

Newly constructed fabric as it comes from the mill is called *greige goods* or *gray goods*. This does not imply that the fabric is gray in colour; it simply denotes any unfinished fabric. The goods must pass through various finishing processes to make it suitable for its intended end use. Finishing may change the appearance of the fabric, its hand (feel), its serviceability, and its durability.

Finishing may take many forms, for it must be adapted to the kind of fibre and yarn used in the fabric and, most important of all, to its intended purpose. One type of gray goods may emerge from a certain finishing process in a form suitable for curtains, while the identical gray goods put through other finishing processes can be used as dress material.

**Kinds of Finishing Processes**

Finishing processes are categorised in several ways. Those concerned with textile processing may classify them as *wet*
and dry finishes. They are also referred to as chemical and mechanical finishes, respectively.

Finishes are also classified according to their degree of permanence. A permanent finish generally involves a chemical process that changes the fibre structure that will not subsequently alter throughout the life of the fabric. A durable finish may last throughout the life of the fabric but its effectiveness diminishes. A semi-durable finish will last through several launderings or dry cleanings; some are renewable. A temporary finish will be removed or substantially reduced when the fabric is laundered or dry-cleaned.

Preparatory Processes

Gray goods must be cleaned before the finishing process. They may contain warp, sizing, oils, other additives, dirt and soil. Complete removal of such extraneous material is necessary in order to finish, dye, and/or print goods effectively. The method of cleaning depends upon the fibre in the fabric, the kind of impurities present, and the construction of the fabric. For example, cotton may be kiered\(^2\) or boiled, wool is carbonised and disentangled, silk is degummed. Knit fabrics are generally dry cleaned by solvent scouring. The use of solvents is particularly desirable because they are recyclable, do not impose a burden on local water and waste disposal systems, and reduce pollution effects.

- **Singeing or Gassing**: If a fabric is to have a smooth finish, singeing is one of the first essential preparatory processes. Practically all cotton fabrics, except those that are to be napped, are singed. Spun rayon fabrics are also frequently singed. But wool and silk fibre ends would cling to themselves and man-made fibre ends would melt

\(^2\) Kier- a vertical tank about 3m in diameter and 4m in height.
resulting in balls on the surface of the fabric. Singeing burns off lint and threads as well as fuzz and fibre ends, leaving an even surface before the fabric passes through other finishing processes or a printing operation.

Singeing is accomplished by passing gray goods rapidly over gas flames, usually two burners to a side, at a speed of 100 to 250 yards (90-225m) per minute. After the cotton cloth leaves the burners, it is pulled through a solution of an enzyme, squeezed out in a heavy mangle\(^3\), and usually allowed to lie for several hours to allow the enzyme to digest the starch with which the warp yarns were sized. In some plants, the singed goods pass directly into a steamer where the sizing is digested rapidly by the heat and moisture.

Singeing may also be done in the yarn stage, especially when the yarns are to be used for fine-quality cotton goods. Usually such yarns are fully mercerised, and singeing in this case is referred to as gassing.

- **Bleaching**: If cloth is to be finished white or is to be given surface ornamentation, all natural colour must be removed by bleaching. This is also necessary if discoloration or stains have occurred during the previous manufacturing process. Bleaching can be done in the yarn stage as well as in the constructed fabric. The kind of chemicals to be used depends upon the kind of textile fibre of which the fabric is composed.

In the case of cotton goods, 85 percent of these fabrics are bleached by continuous peroxide methods. In this system, the singed goods are put through a rapid de-size steamer, washed, impregnated with a mild 3 percent

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\(^3\) Mangle—machine having two or more cylinders, usually turned by a handle, between which wet cloth is squeezed and pressed.
solution of caustic soda, and pulled up into the top of a huge J-shaped container that is equipped to maintain a temperature close to 2120 F (1000C). The J-box is big enough to hold the goods for at least an hour. After this time period, the fabric is hauled out of the J-box, given a hot wash, impregnated with a 2 percent solution of hydrogen peroxide, and put in a second J for another hour. Washing follows, and the fabric goes to the dryers fully bleached. Variations on this process include single-J methods, faster routines, and combinations of peroxide and chlorine bleaching.

Some fabrics are bleached by the older method of first boiling off the goods in kiers, which are large steel vessels that hold about 5 tons of cloth. The goods are boiled for 12 hours under pressure in a 3 percent solution of caustic soda plus soap and sodium silicate. Then they are washed with cold water, pulled out of the kier, washed again, and ‘soured’ by passing them through a weak solution of sulfuric acid to neutralise the alkali. After another washing, they are passed into a 2 percent solution of sodium hypochlorite and piled into bins or pulled up into J-boxes. After lying there for about an hour, they are thoroughly washed, given a ‘white sour’ by running them through a weak solution of sulfur dioxide in water, washed again, and dried for finishing.

- **Mercerizing**: This is an important preparatory process for cotton fabric. It is also used in the finishing of linen. The fabric is usually singed before mercerizing, but mercerizing can either precede or follow bleaching. Mercerizing causes the flat, twisted, ribbon-like cotton fibre to swell into a round shape and to contract in length. The fibre becomes much more lustrous than the original fibre, and its strength is increased by as much as 20 percent.
The process consists of passing the fabric through a cold 15 to 20 percent solution of caustic soda. It is then stretched out on a tenter frame where hot-water sprays remove most of the caustic alkali. A special washer at the end of the tenter removes the balance of the alkali. The process is continuous. Good results require adequate saturation, sufficient tension and thorough washing.

- **Weighting:** The process of weighting is unique to silk fabric only. This process is done to increase the weight of the silk fabric. The process of weighting is done during the dyeing process. To weight coloured silks, stannic chloride is used, followed by treatment with sodium phosphate. Black silks are weighted with metallic mordents, such as iron salt and logwood.

- **Fulling:** Wool fabrics are given a variety of finishes similar to those applied to cotton and linen. But the nature of wool is such that certain other finishing processes are used to obtain a compact, firm body and hand. After the weaving process, woollen and worsted gray goods are placed in warm, soapy water and are pounded and twisted to make the wool fibres interlock. This application of heat, moisture, and pressure followed by a cold rinse, is called fulling. Sometimes chemicals are used to help moisten, soften, and lubricate the fibres.

  Fulling produces a desired shrinkage and gives the fabric additional thickness and a firmer, fuller texture.

- **Crabbing:** To set the cloth and the yarn twist permanently, wool fabric is passed over several cylinders that rotate in hot water and is then immersed quickly in cold water. The cloth is held firmly and tightly to avoid wrinkling.

- **Decating:** It is a shrinkage treatment done for wool through two ways namely dry decating and wet decating.
The dry decating treatment is done if the luster of the fabric is to be set. The fabric is wound under tension on a perforated roller that is then placed in a pre-heated boiler equipped with a vacuum system. Steam is first forced from the inside of the roller through the layers of fabric for two to three minutes; then the process is reversed. The fabric is then removed and cooled by air. The wet decating treatment is done if the luster is to be increased. The fabric is wound under tension on a perforated roller and is placed in hot water at 140° to 212° F (60°-100°C) that is first forced through the roller and fabric and then reversed. The cloth is then removed, cooled with cold water or cold air and dried.

- **Dyeing:** In the dyeing process, the fibre, yarn, or fabric is impregnated with a dyestuff to enhance the look of the fabric. Most commonly, the fabric is dyed by boiling the cloth in a dye bath until the colour is absorbed. The depth of shade depends upon the richness of the bath and the length of time for which the cloth remains in the bath. Several types of machines are used to dye the cloth, most common being the vat dyeing. The vat is an open tank with heating attachments which keep the temperature constant. It contains a series of rollers immersed in the bath, over which the cloth passes. After being dyed, the cloth is often washed in tubs called soapers, to remove excess dye. The cloth is treated to set the dye, either in a liquid bath or through a heated gas chamber.
Most dyes now in use in the textile industry, are of synthetic origin. There are various categories like: acid or basic dyes (used for cotton, wool and silk), direct dyes (used for cotton, wool and rayon), sulphur dyes, azo dyes, vat dyes, mineral dyes and reactive dyes (used for cotton), and dispersed dyes (used for all synthetic fibres).
Health Hazards

Workers in the textile industry face health hazards at every step of the process. Each step has a set of its own hazards though the severity of the problem may change in each process. Though the hazards at workplace have a direct bearing on the health of the worker, it gets aggravated due to certain other factors also like malnutrition, personal habits like smoking and drinking and the physiological make-up of the worker. For instance, women workers, due to their biological differences, excess workload of home and factory and poor nutritional intake become more prone to hazards than their male colleagues.

To understand the problem in depth, the various hazards faced by the workers are divided into four categories namely, dust hazards, chemical hazards, physical hazards and other hazards.

A. Dust Hazards

Vegetable Dust

Exposure to vegetable dusts presents a major health problem in the textiles and allied industries. Exposure to cotton and flax dusts in the textile industry occur during bale opening, blowing (cotton), sorting (flax), carding, spinning and weaving. The hazardous textile dusts fall into two distinct groups.

Firstly, there are those of cotton, flax and soft hemp which give rise to the disease called Byssinosis or Brown lungs. Byssinosis is a chronic occupational lung disease. Cotton dust present in the air, inhaled by the worker enter the alveoli of the lungs after inhaling. Alveoli are minute air sacks which make close contact with the blood that flows in
the lungs. Here the blood receives oxygen and discharges carbon dioxide. As the cotton dust penetrates the alveoli, it gets accumulated in the lymphatics (very fine tubes in the central area of the lung). Continuous accumulation of the dust in the lungs damages the alveoli and reduces the capacity to retain oxygen. As the cotton dust accumulation increases, the worker develops brown lungs and suffers from byssinosis.

The main symptoms of byssinosis or brown lungs are cough and phlegm or sputum along with varied types of chest irritation, breathlessness and low fever. The first indications of this disease, are occasional chest tightness or respiratory irritation, on the first day of the working week. This is commonly known as Monday Sickness. In the second stage, these symptoms are noticed on the first day of every week. By the time the disease reaches the third stage, the patient complains of tightness of the chest and shortness of breath, all through the working week. In the final stages of the illness, these symptoms become more acute, so much so, that the patient suffers a permanent incapacity of reduced breathing capacity.

The second type of dust that is derived from hard vegetable fibres, can cause non-specific irritation in the respiratory tract; with prolonged exposure, this may lead to non-specific chronic obstructive pulmonary disease. Mill fever and Weaver’s cough have also been associated with cotton and flax handling. Mill fever generally occurs on the first exposure to a cotton dust environment and lasts for 2-3 days. It is characterised by headache, uneasiness and fever. Weaver’s cough is commonly observed among workers in the weaving section suffering from outbreaks of acute respiratory illness characterized by dry cough. It is caused from sizing material or from mildewed yarn that is sometimes found in high-humidity weaving rooms.
Animal Fibres

- **Wool**: Dust is produced in high quantities by machines in tearing or carding action. The dust level is sufficient to induce irritation of the respiratory tract mucosa. Another hazard usually associated with wool industry is Pulmonary Anthrax. This disease is a result of inhalation of dust containing anthrax spores. Anthrax is an infectious disease primarily of animals from which human beings may be secondarily infected. The disease is also known as wool sorters' disease. It begins suddenly after a short incubation period and assumes the form of severe haemorrhagic pneumonia and within 24-28 hours, death follows.

Mineral Fibres

- **Glass**: Glass fibre itself is not a sensitising agent. However contact with uncured resins, hardeners and accelerators while handling glass fibres may give rise to skin sensitivities. Most workers handling glass fibre for the
first time suffer from a transient irritation of the exposed parts of the skin. This is usually accompanied by itching erythema\(^4\) with spots which pass off with continued exposure in the course of a few days or few weeks. The skin is then said to be hardened, but if the exposure is interrupted by absence from work or is not enough to maintain hardening, the rash would recur and the process starts again.

- **Asbestos**: The commercial production of asbestos textiles started in Italy between 1850 and 1870. The manufacture of asbestos textiles used to be one of the dustiest processes of all asbestos product manufacturers. The asbestos textiles industry has expanded rapidly in the past 70 years, and especially since the 1940s. Asbestos fibres can be spun and woven using modified cotton industry machinery.

Asbestos fibres are liberated in the air in dangerous amounts at all stages of the asbestos textile industry, especially in the spinning operation. The risks are highest where the dust contains the largest number of fine fibres. The chronic inhalation of asbestos particles at workplace causes a disease called Asbestosis, which means a gradual obstruction and damage to the lungs. The asbestos dust can pass through the natural filter system of the nostrils and the mucous lining of the air tubes and make its way into the lower lobes where it later, becomes impacted in the respiratory bronchioles and beyond. Later it leads to fibrous thickening of the walls of the alveoli and turns the elastic tissues inelastic.

Common symptoms of asbestosis are insidiously progressive breathlessness and sometimes dry cough at night or in the morning. Consequently, there is a decrease in the capacity to work. In some cases, chronic bronchitis also simultaneously develops. Asbestosis has a long latent period for manifestation and can progress even after the exposure has ceased.

\(^4\) *Erythema*—redness of inflammation of the skin or mucous membranes.
Incidence of lung cancer in patients suffering with asbestosis has been found to be about 10 times higher than in the general population. An association between asbestosis and bronchial cancer was discovered, especially in asbestos textile workers, in the mid-1930s. The association is now generally accepted and appears to be with asbestosis rather than simply past exposure to asbestos dust. In the United Kingdom, between 30 and 50 percent of the cases in which asbestosis was discovered by post-mortem examinations, also showed bronchial or mesothelial tumours. Mesothelioma is a lethal disease which can be caused only by asbestos exposure and nothing else. The symptoms seen in patients suffering from mesothelioma are breathlessness of sudden/gradual onset, discomfort or heaviness of one side of the chest, patchy changes in skin sensation and sweating.

**Synthetic Fibres**

Synthetic fibres are made from polymers that have been synthetically produced from chemical elements or compounds obtained from the petrochemical industry. The main groups of substances from which the fibres are produced include polyamides, polyesters, polyvinyl derivatives, polyolefins, polypropylenes, polyurethanes and polytetrafluoroethylenes.

Health hazards from the inhalation of synthetic polymer dust have not yet been well documented. In one study (1978) in the USSR it was reported that the examination of 279 workers exposed to polymer dust in industries processing polyamide, polyacrylate and polyester fibres (in the manufacture of synthetic furs, carpets and non-woven fabrics) had revealed respiratory disorders among some of them. It was also reported in the same study, that polymer dust administered to rats had proved to be mildly fibrogenic and toxic and a cause of irritation.
Hazards in the Silk Industry

Dermatitis of the hands of female workers reeling raw silk has been widely described. Skin lesions on fingers, wrists and forearms are characterised by erythema covered with small vesicles which are extremely painful has been noticed among female silk workers. The cause of this condition is attributed to the decomposition product of a parasite in the cocoon and also to the temperature of the reeling bath.

The handling of raw silk may produce allergic skin reactions; in some reel workers, facial swelling and ocular inflammation were observed where there was no direct local contact with the reeling bath. Similarly, dermatitis has been found among silk throwsters.

Long term epidemiological observations carried out in the USSR have shown that in the natural silk industry respiratory allergy may occur with bronchial asthma, bronchitis and allergic rhinitis. It appears that natural silk can cause sensitisation at all production stages.

Source: Encyclopaedia of Occupational Health and Safety; ILO, Volume 2, Third (Revised Edition)

B. Chemical Hazards

Chemical hazards in textile industries processing vegetable fibres include exposure to bleaching agents, acids and alkali,
degreasing agents, chemical dyestuffs and intermediates. The manufacture of synthetic textile fibres, in turn, involves the use of toxic chemical substances that are usually polymerised to produce the fibres.

- **Dyes and Dye Stuffs**

Dyes are normally supplied as powders. Therefore there is a high risk of inhalation and/or skin absorption and even ingestion of the dye powder. Dyes are produced by different chemicals which affect the human system in different ways.

There has been a considerable history of occupational diseases in the dyeing industry. Bladder cancer is one of the most serious occupational hazard for synthetic dye workers followed by tumour of the urinary bladder caused by benzidine.

One group of dyestuffs that present acute health hazards are the ‘fast salts’. They are used in dyeing to form a dye on the fibre by reacting with other chemicals (napthols) with which the fibre has already been impregnated. Fast salts are the stabilised diazonium salts of aromatic amines. They are highly reactive compounds and inhalation of the dust may lead to respiratory sensitisation and asthma. Sensitisation of the respiratory system has also occasionally been observed with other reactive dyes.

Contact Dermatitis is a common problem suffered as a result of handling of dyes. Occupational Contact Dermatitis also known as occupational eczema is a skin disease caused by exposure to chemical, physical or biological agents present in the work environment. The skin becomes red and itchy and tiny blisters develop. The incidence of dermatitis is more frequently found in industries using synthetic fibres than those using natural fibres. Some acid dyes (used for dyeing wool) are chromium complexes of typical azo
structures, but despite the introduction of chromium into the dyestuff molecule, such products are not known to be more apt to induce skin sensitisation than other dyes. However, certain aromatic amino compounds are skin sensitizers. Many cases of sensitisation have been attributed to tetryl (tetranitro-monomethyl-aniline), p-aminophenol and p-phenylenediamine. The last named compound is also a respiratory sensitiser and may cause asthma in sensitised individuals.

Another chemical, trichloro-S-triazine has a severe irritant effect on the eyes and respiratory passages, but less effect on skin. Some alkaline dyes, if splashed into the eyes accidentally, can produce serious lesions and lead to loss of vision.

A major problem for workmen handling dyes is the ease with which the superficial layers of the skin become dyed. Thus, problems of skin cleansing arise. The usual types of skin cleansers have little effect. The most usual method is to use sodium hypochlorite solution, which effectively bleaches the dyed skin. Hypochlorite is itself a powerful irritant which can destroy the skin.

The chemicals used in various dyes are also suspected to lead to reproductive disorders among both men and women. A few textile dyes have been reported to affect the fertility among workers and cause spontaneous abortions among women workers.

Quite a number of the dye stuffs are also capable of affecting the red blood cells by forming metheamoglobin in the blood.

• **Bleaching Agents**

Bleaching agents are substances or mixtures that have the ability to remove chemical dyes or pigments that exist naturally in a material or that have been added to textile
material. Their action is based on the principle of oxidation. Invariably, these substances exhibit the same chemical reaction - oxidation - on the exposed human tissues. Hence, bleaching agents should be used with due precautions. The common bleaching agents include chlorine, calcium hypochlorite, sodium hypochlorite, potassium hypochlorite solution, chlorine dioxide, and sodium chlorate. Miscellaneous bleaching agents include sodium peroxide and hydrogen peroxide.

Chlorine can affect the mucous membrane, respiratory system, skin and eyes and is a dangerous pulmonary tissue irritant causing delayed lung oedema.

Of the miscellaneous bleaching agents, sodium peroxide and hydrogen peroxide are the most hazardous substances. When mixed with organic substances, they may be subject to explosive reactions; they may cause chemical burns of the skin and mucous membranes.

- **Acids and Alkalis**

These are used in various stages of textile production. The acids used in the textile processes are corrosive, especially in high concentration, and will destroy body tissue and cause chemical burns when in contact with the skin and mucous membranes. In particular, the danger of eye damage is pronounced. Inorganic acid vapours or mists are respiratory tract and mucous membrane irritants. The degree of irritation depends, to a large extent, on the concentration. Repeated skin contact may lead to dermatitis.

The main alkalis used in the textile industry include ammonium hydroxide, calcium hydroxide, sodium and potassium hydroxides and carbonates, peroxides and silicates. The alkalis, whether in solid form, or in concentrated liquid solution, are more destructive to tissue than most acids.
**Occupational Asthma**

Occupational Asthma is a disorder initiated or provoked by agents found in the work environment causing asthmatic signs and symptoms either due to excessive concentration of those agents or because of an exaggerated response by the individual worker. Occupational Asthma can affect a worker in two ways. Firstly, by breathing in substances like dust, chemicals and fumes at work can cause a normal healthy person to develop asthma. Secondly, breathing in substances at work ‘triggers’ asthma attacks in those who already have asthma. If a worker has or is developing asthma, symptoms shown may include chest tightness, wheezing, shortness of breath and bouts of coughing - dry or with mucus. A common pattern among persons suffering from occupational asthma is that during the week, the symptoms get worse. The symptoms may only occur or get worse after returning home, sometimes interrupting sleep. The symptoms may get better on the weekend or when on holiday. Once sensitised, continued exposure can result in increasingly severe symptoms.

Some of the agents which can cause asthma or trigger an asthma attack among textile workers are cotton dust, fumes, dyes and bleaching agents, animal fibres like wool etc, and silk.

Source: Dr. Murlidhar V., Vijay Kanhere; Diagnosis of Occupational Diseases; Pub: Society for Participatory Research in Asia, New Delhi; 1996

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**C. Physical Hazards**

- **Noise**

A number of processes in the textile industry, especially cardroom, blowroom, spinning and weaving produce a lot of noise. The noise level within a textile factory is very high resulting in disorders among the workers who work there the entire day. The noise level in the factory exceeds 90 dB.
and therefore poses a health problem. Noise is produced when looms, motors, ventilators and other devices are being operated. Automatic flying shuttle looms tend to produce higher noise levels than the conventional looms.

Exposure to noise may cause annoyance, interfere with speech communication and be a source of distraction. Hearing loss, as well as neurological, cardiovascular and endocrine changes, have been reported among textile mill workers, together with effects on rates of production, accidents and absenteeism. Studies have shown that noise above a certain level can produce variations in heart-rate, blood pressure, respiration, and dilation of pupils. Significant increases in blood pressure have been reported among workers exposed for a long time to high levels of noise. Higher prevalence of peptic ulcer can also be a result of loud noise-exposed groups.

- **Vibration**

In almost all processes of textile weaving, machinery and power-driven tools can be encountered which generate intense vibration that may be transmitted to the workers who operate them. The difference between vibration and noise is that a worker can get affected by noise even if he is not in direct contact with the noise-producing machine.
whereas vibration affects only the worker who is in contact with the vibrating body.

Vibration affects the comfort, reduces work output and causes disorders of physiological functions in human beings, giving rise to the development of disease in the event of intense exposure. Vibration is a physical factor which acts on the worker by transmission of mechanical energy from sources of oscillation. Sources of vibration may be knocks, friction of machine mechanisms, inaccurately centred or badly balanced rotating masses, pressure pulses of compressed air etc.

Vibration can be sub-divided into general or whole body vibration, which acts on the body of sitting or standing persons through supporting surfaces and local vibration, which is mainly transmitted to the hands and arms. Sources of whole body vibration are encountered more in the weaving looms.

The effects of vibration can be observed more in terms of vascular disorders and sensory disorders. Exposure to whole body vibration impairs visual acuity, narrows the field of vision, diminishes the light sensitivity of the eye and disturbs the vestibular function. One of the prominent effects of vibration is called the 'white finger'
or vibration disease. Prolonged exposure to vibration, especially in combination with other harmful factors like cold, noise, and static loads can lead to vibration disease. The most prominent feature of this disease is a vascular syndrome accompanied by spells of 'white finger' after general or local body cooling, and also by impaired sensitivity to vibration, pain and temperature.

In the first stage of this disease, pain is felt occasionally and a slight loss of vibration sensitivity of the finger tips is observed. In the second stage, pain and feeling of numbness are more persistent, loss of sensitivity spreads to all fingers and to the forearm, skin temperature of the finger diminishes. These changes are reversible. In the third stage, the fingers become white, the hands are generally cold and moist, all types of sensitivity of the hands are diminished, the muscular changes are more pronounced and the functional changes in the central nervous system become noticeable. All these changes are persistent. In the fourth and final stage, the changes become general. Vascular disorders can be observed in the arms and legs, there may be fits of dizziness and sensitivity is even more diminished. The state is persistent and only partially reversible.

•  **Thermal Environment**

The heat generated by machines specially in spinning and weaving rooms raises the internal temperature of the factory to a great extent. The problems of temperature, humidity and ventilation in the textiles industry can cause a lot of discomfort to the workers and also result in reduced work efficiency.

In textile finishing mills, the inside temperature is even greater owing to the heat from the steam-heated dyeing plants and finishing machines. Many textile factories are equipped with artificial humidification plants, the continued use of which
worsen the situation with regard to the thermal effects on the exposed workers.

In textile finishing processes, the temperature of workrooms may often be too high owing to a failure to lag adequately steam pipes and other hot surfaces. Too many apparatus releasing steam vapour into the working atmosphere, if installed in the same room, can considerably increase the humidity load and temperature. Poor ventilation aggravates the situation as the surplus steam vapour is not released out.

When a worker's physiological capacity to compensate for thermal stress is exceeded, heat can lead to impaired performance, an increased risk of accidents, and clinical signs of heat illness. The mildest form of heat stress is discomfort. Heat rash is common in warm-moist conditions due to inflammation in sweat glands plugged by skin swelling. Heat cramps result after prolonged exposure to heat with inadequate replacements of fluids and electrolytes. Finally, there is heat stroke, a medical emergency that often occurs in a setting of excessive physical exertion. The underlying physiological disturbance is failure of the central nervous system sweat control, thus leading to loss of evaporative cooling. This is followed by dizziness, nausea, irritability, severe headache and hot and dry skin and the process quickly leads to confusion, collapse, delirium and coma.

**D. Other Factors**

**Ergonomic Factors**

Apart from dust hazards, chemical hazards and physical hazards in the textile industry, various other factors present in the workplace affect the capacity, performance and the health of workers. Most of these are directly related to the human being at work, the task to be performed by him and
the machinery and equipment used. In broad terms they may be called ‘ergonomic factors in the work environment’.

The application of ergonomics or work norms in industry is aimed at matching the demands of the task to be performed with the optimum performance of the worker. In the field of occupational health and safety, ergonomics, anthropometric systems are mainly concerned with body build, composition and constitution, and to the dimensions of the human body in relation to machines, the industrial environment and clothing.

The physical capacity of the worker may be affected by the machine design in relation to anthropometry, workload, work posture, shift system, work organisation, lighting at the workplace, and the physiological stress induced by changing technology.

- **Machine Design:** The textile workers in a conventional cotton mill have to ensure the continuous flow of material from bale opening, to blending, cleaning, carding, twisting, spinning, winding and preparation for bulk dispatch. In an ideal situation, the working conditions should be such that workers would perform their tasks at their optimal capacity without undue physical and mental effort.
For a machine operator to produce optimal work, the machine should be designed taking into consideration the anthropometric characteristics of the operator. In practice, when machines are designed in industrially developed countries, they are usually built to fit the average body size of the general population in that country or region.

Therefore, in situations where machinery designed in developed countries is imported into developing countries where the working population have different anthropometrical characteristics, the workers develop muscle strain and fatigue when operating the machines. For example, a worker may find it difficult to reach an operating handle or switch in a sitting posture (because his arm is too short) and may be forced to work standing during the whole work shift.

Even when the worker is able to perform the work seated, unless the chair is properly designed in relation to the working height and the operating controls are within easy reach, he will not be comfortable and may develop symptoms of fatigue and stress.

- **Work Posture:** In factories, the workers keep standing for long periods. The standing posture, in addition to fatigue, can lead to development of flat foot and venous system disorders in the lower limb.

- **Lighting:** Certain work processes in textile industry, like weaving and cloth examination require the work area to be well-lit with higher levels of illumination. Due to the poor lighting conditions, the workers suffer from exhaustion, eye fatigue and over-exertion. Also, under poor lighting conditions unnatural work postures may have to be adopted by the workers in order to perform their jobs.
Automation

Health problems related to the working environment in the textiles and allied industries have increased considerably and, to some extent, changed in nature, especially over the past few decades, because of the gradual automation of work. This development has also been due to the use of complex machinery and equipment which, while reducing physical effort, has often resulted in the fragmentation of work into a limited number of simple operations and speeding up of the pace of work. The industrial worker thus tends to resemble a robot, repeating the same gestures throughout the shift, keeping up with the machine’s relentless pace. These factors often cause psychological overload and sensory and nervous fatigue, which is more insidious than physical fatigue. This situation not only produces a harmful effect on the worker’s health but is also conducive to accidents at work.

Shift Work

In the textile industry, where shift work is very prominent, the problems faced due to shift work are also widely observed. Some of the basic health disorders related to shift work are disruption of sleeping patterns, accumulation of fatigue, variations in eating habits and changes in psychological environment.

Disruption of sleep patterns occur when shift workers are prevented from sleeping at the normal time. The shortening of sleeping time is known to occur especially in the night shift period. Daytime being unfavourable for sleep due to noise from traffic and daily life, sleep shortage of shift workers tends to accumulate. The poor quality of daytime sleep is evidenced by an increased frequency of awakenings and the reduction of deep sleep periods.
The lack of sufficient sleep results in fatigue and reduced work efficiency. These changes are closely connected with the cycle of basic physiological parameters, such as body temperature, which affects the arousal conditions. These changes are most remarkable around 3 to 5 a.m. when the normal body temperature curve reaches its minimum. As the sleep duration and quality are affected by night work, so is the recovery from fatigue from night work. Fatigue tends to accumulate during the night shift period. Operation errors at monitoring tasks are found to occur with the greatest frequency between midnight and early morning hours also leading to industrial accidents occurring more frequently during this time.

Eating habits are affected in accordance with the phase-changes of work and sleep. Not only the sequence and time of meals, but also the appetite and the food taken are affected. Thus meals become irregular, and it is often difficult for shift workers to get appropriate meals at appropriate times. As a result, digestive disorders and gastrointestinal complaints increase among shift workers.

Shift work interferes to a great extent with family and social life often leading to psychosocial problems. With different sleeping and working hours from their family members and friends, the workers are alienated from the daily schedules of others and slowly their family life and social life get restricted.
Control of Hazards

As seen in the earlier sections, the production process in textile manufacture is not free from hazards. The whole process being so complicated and long, involves a series of steps where workers are exposed to hazardous substances. None of the steps in the whole process can be termed as absolutely safe, though the extent of hazard may differ. The aim of this section is to understand how we can minimise these hazards and make the workplace safer and better for the workers.

All the workplace hazards can be controlled through a variety of methods. There are different methods of controlling hazards. Some are more efficient than others, but generally a combination of methods proves more beneficial. Before adopting any control method in the workplace, a proper assessment of the workplace should be done. In order to get effective results, the workplace should be properly observed and studied before any of the control measures are started. An assessment of the health and safety conditions in the workplace helps in knowing the extent of the effect it has on the workers. Some of the parameters of assessing this could be probing into the complaints made by workers regarding their health, examining the number of accidents and injuries taking place in the workplace and finding out the various steps/substances which could be the cause of the workers’ complaints.

Hazards can be controlled at three steps i.e. at the source, at the transmission path and at the level of the worker.

<table>
<thead>
<tr>
<th>Source</th>
<th>Transmission</th>
<th>Worker</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elimination</td>
<td>Enclosure</td>
<td>P.P.E</td>
</tr>
<tr>
<td>Substitution</td>
<td>Isolation</td>
<td>Creating Awareness</td>
</tr>
<tr>
<td>Anticipatory Methods</td>
<td>Ventilation</td>
<td>Medical Surveillance</td>
</tr>
<tr>
<td></td>
<td>Wet Methods</td>
<td></td>
</tr>
</tbody>
</table>

Looms Weave Gloom 45
Controlling at Source- means taking care of the hazard before it enters the production cycle. By far, the most useful and necessary process, where the hazards are controlled at their source itself. The three different ways of controlling hazard at source are briefly mentioned below:

- **Elimination**: In this process, the hazardous substance is completely removed from the work area. For e.g. it is a known fact that asbestos fibre is very hazardous for any worker coming in contact with it. Earlier, low doses of asbestos dust was permissible but research showed that any amount of asbestos is harmful to the human body. So the only solution left was complete elimination of the asbestos fibre from the work area.

Elimination of a specific hazard or hazardous work process, or preventing it from entering the workplace, is the most effective method of control, though not always feasible, as, at times, that particular chemical, substance or machine is vital to the production process. In that case, the next step i.e. substitution is adopted.

- **Substitution**: In cases where a dangerous chemical or work process cannot be eliminated, then it is replaced by a less dangerous, or safer substitute. Through this process, the hazardous product is substituted by a less hazardous substance. For example using less hazardous solvents instead of toxic ones such as toluene, cyclohexane or ketones instead of benzene. The underlying condition for substitution should be that the substituted substance is less hazardous than the previous one and does not pose a fresh set of hazards to the workers. Many a time, in order to substitute a chemical or substance, a new product is introduced without adequate research done on it. For example, fibreglass has been used as a substitute for asbestos. However, it is known that fibreglass is also a hazardous material and not a completely safe substitute for asbestos.
• **Anticipatory Methods:** Through this, the production process is carefully monitored and if there is an early warning that a particular process/substance is hazardous or going to be hazardous, then adequate measures are taken to tackle it.

**Transmission Path:** Controlling hazards at the transmission path involves measures to control it when the hazard cannot be controlled at the source. Here the hazards are controlled during the production process. The various methods of controlling at the transmission path are listed below:

• **Enclosure:** Many hazards can be controlled by partially or totally enclosing the work process. This is the second best method if elimination or substitution is not feasible. For example, if toxic materials are released in the air, they should be totally enclosed, usually by using a mechanical handling device or a closed glove system that can be operated from the outside. Another example is of ‘machine guarding’ that prevents workers from coming in contact with dangerous parts of machines. In some cases, whole areas of a plant can be enclosed by requiring workers to operate those from a control room.

The enclosure helps in reducing exposure but not eliminating the exposure completely as the workers do come in contact with the machine or chemical from time to time.

• **Isolation:** This method can be applied in two different ways i.e. by isolating a particular hazardous process or by isolating the worker from the hazardous process. In the case where the process is isolated, it can be moved to a part of the workplace where fewer people will be exposed, or by changing it to a shift when fewer people are exposed like weekend or midnight shift. In the other case, where the
worker is isolated, it is done when the process is too large to isolate or difficult to run on shifts. In such a case, the worker is removed from the hazards and he controls the production process from a control booth. For example, if the work area is extremely hot, the worker is separated in an air conditioned room from where he controls the machines.

Whether it is the worker or the process which is isolated, access to the hazardous work area should be limited to as few people as possible. The length of time and the amount of a substance to which workers are exposed should also be limited.

- **Ventilation**: There are two categories of ventilation, i.e. local ventilation or general ventilation. Ventilation in the workplace can be used for two reasons, firstly for preventing the work environment from being too cold, hot, dry or humid and secondly to prevent contaminants in the air from getting into the area where workers breathe.

  **Local Ventilation** generally uses suction, based on the principle of a vacuum cleaner, to remove pollutants from the air. Partial enclosure combined with a local exhaust ventilation system is one of the best solutions for controlling toxic material. This type of system must operate as close as possible to the source of the hazardous agent to reduce it from spreading, yet at the same time, allow access to the work process.

  **General Ventilation** is generally used for keeping the workplace comfortable. It is one of the least effective methods of controlling hazards but one of the most commonly used. The purpose of any general ventilation

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5 Controlling Hazards; your health and safety at work; ILO, Pg 12,13
system is to remove contaminated air and replace it with 'fresh air'. This system does not really remove hazardous agents from the air but simply reduce the amount in the air to levels that are considered 'safe' for breathing. The effectiveness of a general ventilation system depends on several things, like how quickly the hazardous agent is being released into the air, how much and how quickly fresh air is coming in and how the contaminated air is being removed.

**Wet Method:** This is used to reduce the amount of dust in air. In this method, water is sprayed over a dusty surface to keep the dust down or water is mixed with the material used to prevent dust from being created.

**Worker:** Working at this stage should be used in combination with other methods listed above. If used solely, they are least effective and difficult for the worker. The various steps which can be taken with the worker are discussed below:

- **Personal Protective Equipment (PPE):** Use of
PPE should be the last measure when no other solution is feasible. PPE are the least effective method of controlling hazards. They are uncomfortable to the worker and can decrease the work performance as they pose a hurdle to the worker while working. Examples of PPE include safety glasses, ear protectors, respirators with filters, dust masks, gloves, protective shoes and safety shoes. The advent of PPE was to give protection to the worker for a short while if he is in a hazardous condition. They were not meant to be used for a long time. But the scenario at present is such that the instead of controlling the hazards at the workplace, the workers are expected to use PPE all the time to prevent themselves from hazards. This poses a different set of hazards to the workers and also tendency to avoid their use as they are uncomfortable. Some examples of the hazards posed due to the use of PPE are, using ear protectors can prevent a worker from hearing a warning signal, respirators can make it harder to breathe, earplugs can cause infection, low quality gloves can cause skin infections like dermatitis.

It is important that proper training be given to the workers on how to use the PPE, their maintenance and their limitations.

- **Creating Awareness:** among workers is very essential as they are in the closest contact with the workplace. Ideally, it is the workers who should be knowing everything about the production process but, in reality, they know the least. Various factors play a vital role for this lack of information among the workers. First and foremost, information is not given to the workers regarding what they are using, how it is hazardous for them etc. Secondly, if information is given, it is given in such technical or alien language that a worker is unable to grasp it since his level of education and the management’s level of education differs a lot. Also, in production processes, like textile production, where a series
of steps are involved, workers spend years in one department only, not knowing how they are contributing to the whole process. Each process is compartmentalised and the worker is not involved in the whole production cycle. This results in apathy to the work and a disinclination towards knowing more about the hazards.

With all the above factors prevailing, it is necessary that workers should be given regular training to make them aware and also to keep them updated with the new developments. It is important here, that the training should be participatory, where the workers participate equally in sharing information. Through a participatory approach, the worker would come up with problems faced at the workplace and jointly solutions can be worked out. Also, if a worker is aware he will take more precautions in reducing his exposure to hazardous substances.

- **Medical Surveillance:** Regular medical surveillance helps in assessing the prevalence of workplace diseases in a particular workplace. Through regular check-ups, hazards can be controlled if the worker is responding negatively to them and the worker can be given a different work to do if a particular work process, is deteriorating his health. For example, if a person working in the spinning department starts showing symptoms of respiratory problems, he can be transferred to some other department where the dust level is low. Medical surveillance should be done at three stages i.e. pre-employment, pre-placement and during employment

  **Pre-Employment:** This is done before the person joins a workplace. Through the medical check-up, the prospective worker’s general health is monitored and if he is fit to work, he is recommended to start at a particular workplace.

  **Pre-Placement:** This check-up is done before
transferring a worker to a new department to assess if the worker is fit to work in the new set-up.

**During Employment:** Regular check ups to assess if the worker is showing any deterioration. This also helps to know as to how the hazards are affecting him as when the worker joined and his pre-employment check-up shows that he was healthy and if after a certain time he reports illnesses, a connection can be developed between his health and the workplace.

**Conclusion:**

All the above mentioned methods of controlling hazards at the workplace can be used in isolation or in combination, depending on each workplace. There is no dearth of controlling methods at the workplace. The need of the hour is to adopt these and bring a change in our prevalent attitude of putting the responsibility of protecting oneself solely on the worker. The management who is in control of the production process, the information and the control methods, has to realise, that by implementing techniques for a safe workplace, they are not only benefiting the workers but also their own production cycle, as only a healthy workforce can lead to better and more efficient production. In the long run, it is more profitable to invest in a better workplace, as a healthy and happy worker will be an asset to the management and not a sick and ailing worker.
<table>
<thead>
<tr>
<th>Method</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elimination</td>
<td>Health Hazard is removed</td>
<td>Possible sacrifice of production and loss of jobs</td>
</tr>
<tr>
<td>Substitution</td>
<td>Health Hazard is removed and production continues</td>
<td>New Hazard may be introduced</td>
</tr>
<tr>
<td>Enclosure</td>
<td>Maximum reduction of exposure</td>
<td>Not 100 percent under control; accidents and leaks possible</td>
</tr>
<tr>
<td>Ventilation</td>
<td>Some reduction of exposure</td>
<td>Largely inadequate on its own; exposures easily occur if not used with enclosure; only helps to control airborne hazards</td>
</tr>
<tr>
<td>Personal Protection</td>
<td>Minimal reduction of exposure</td>
<td>Depends on work habits; burden of control rests largely on the individual worker; contamination or failure of gear</td>
</tr>
</tbody>
</table>

Source: Controlling Hazards, Your Health and Safety at Work, ILO Publication, Page 22
Bibliography


11. Dr. Murlidhar V., Vijay Kanhere; *Diagnosis of Occupational Diseases*, Society for Participatory Research in Asia, December 1996.

12. International Labour Office; *Controlling Hazards, Your Health and Safety at Work*, 1996
## Annexure
### Export of Textiles

<table>
<thead>
<tr>
<th>S. No</th>
<th>Item</th>
<th>Exports 1993-94 Rs.</th>
<th>Exports 1994-95 Rs.</th>
<th>Target 95-96 US$</th>
<th>Exports 1995-96 Rs.</th>
<th>% Increase Rs.</th>
<th>% Increase US$</th>
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<td><strong>2600</strong></td>
<td><strong>10390.04</strong></td>
<td><strong>3124.98</strong></td>
</tr>
<tr>
<td>---</td>
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<td>---------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>2</td>
<td>Ready-made Garments</td>
<td>11648.06</td>
<td>3713.65</td>
<td>13921.62</td>
<td>4433.83</td>
<td>4800</td>
<td>14806.49</td>
</tr>
<tr>
<td>3</td>
<td>Woollen Textiles</td>
<td>605.10</td>
<td>192.92</td>
<td>537.53</td>
<td>171.20</td>
<td>200</td>
<td>660.73</td>
</tr>
<tr>
<td>4</td>
<td>Silk Textiles</td>
<td>789.26</td>
<td>251.63</td>
<td>937.31</td>
<td>298.52</td>
<td>328</td>
<td>843.11</td>
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<tr>
<td>5</td>
<td>Man-made Textiles</td>
<td>1843.71</td>
<td>587.81</td>
<td>2463.51</td>
<td>784.59</td>
<td>850</td>
<td>3109.40</td>
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<td>6</td>
<td>Coir</td>
<td>126.85</td>
<td>40.44</td>
<td>166.12</td>
<td>52.91</td>
<td>55</td>
<td>189.66</td>
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<tr>
<td>Total</td>
<td></td>
<td>21313.90</td>
<td>6795.31</td>
<td>26764.75</td>
<td>8524.19</td>
<td>8833</td>
<td>29999.43</td>
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</table>

Value in Rs. Crores and Millions US$

Source: Export Promotion Council and Commodity Boards
### Production of fabrics in different Sectors

(Mn. Sq. Mtrs.)

<table>
<thead>
<tr>
<th>Sector</th>
<th>1994-95</th>
<th>1995-96(P)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mill Sector</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cotton</td>
<td>1262</td>
<td>1169</td>
</tr>
<tr>
<td>Blended</td>
<td>746</td>
<td>611</td>
</tr>
<tr>
<td>100% Non-Cotton</td>
<td>263</td>
<td>256</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2271</strong></td>
<td><strong>2036</strong></td>
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<tr>
<td><strong>Handloom Sector</strong></td>
<td></td>
<td></td>
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<tr>
<td>Cotton</td>
<td>5429</td>
<td>6115</td>
</tr>
<tr>
<td>Blended</td>
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<td>5</td>
</tr>
<tr>
<td>100% Non-Cotton</td>
<td>738</td>
<td>900</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6180</strong></td>
<td><strong>7020</strong></td>
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<tr>
<td><strong>Powerloom Sector</strong></td>
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<td>Cotton</td>
<td>7021</td>
<td>6887</td>
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<tr>
<td>Blended</td>
<td>2640</td>
<td>2573</td>
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<tr>
<td>100% Non-Cotton</td>
<td>6315</td>
<td>6872</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>15976</strong></td>
<td><strong>16332</strong></td>
</tr>
<tr>
<td><strong>Hosiery/Knitted Sector</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cotton</td>
<td>3307</td>
<td>4244</td>
</tr>
<tr>
<td>Hosiery</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Blended</td>
<td>262</td>
<td>261</td>
</tr>
<tr>
<td>100% Non-Cotton Hosiery</td>
<td>179</td>
<td>258</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3748</strong></td>
<td><strong>4763</strong></td>
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<tr>
<td><strong>All Sectors</strong></td>
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<tr>
<td>Cotton</td>
<td>17019</td>
<td>18415</td>
</tr>
<tr>
<td>Blended</td>
<td>3661</td>
<td>3450</td>
</tr>
<tr>
<td>100% Non-Cotton</td>
<td>7495</td>
<td>8288</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>28175</strong></td>
<td><strong>30151</strong></td>
</tr>
<tr>
<td>Khadi, Wool and Silk</td>
<td>431(P)</td>
<td>431*</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>28606</strong></td>
<td><strong>30582</strong></td>
</tr>
</tbody>
</table>

*P* = Provisional;  * = Previous year's figure repeated
## Growth in Capacity in the Organised Mill Sector

<table>
<thead>
<tr>
<th>Year</th>
<th>Spg. Mills</th>
<th>Com. Mills</th>
<th>Total</th>
<th>Installed Nos. of</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Spindles (Mn)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Rotors ('000)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Looms ('000)</td>
</tr>
<tr>
<td>31.12.1951</td>
<td>103</td>
<td>275</td>
<td>378</td>
<td>11</td>
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<tr>
<td>31.03.1989</td>
<td>769</td>
<td>282</td>
<td>1051</td>
<td>26.46</td>
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<tr>
<td>31.03.1990</td>
<td>770</td>
<td>281</td>
<td>1051</td>
<td>26.59</td>
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<td>31.03.1991</td>
<td>777</td>
<td>285</td>
<td>1062</td>
<td>26.67</td>
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<td>31.03.1992</td>
<td>846</td>
<td>271</td>
<td>1117</td>
<td>27.82</td>
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<tr>
<td>31.03.1993</td>
<td>874</td>
<td>268</td>
<td>1142</td>
<td>28.09</td>
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<tr>
<td>31.03.1994</td>
<td>909</td>
<td>266</td>
<td>1175</td>
<td>28.6</td>
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<tr>
<td>31.03.1995</td>
<td>1148</td>
<td>268</td>
<td>1416</td>
<td>30.7</td>
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<td>31.01.1996(P)</td>
<td>1201</td>
<td>274</td>
<td>1475</td>
<td>31.14</td>
</tr>
</tbody>
</table>

*Looms Weave Gloom*
Diseases at Work II - Reference Sheets on Diseases for which Compensation may be claimed (English/Hindi)

This is the second set of reference sheets on diseases at the workplace, in which an attempt is made to disseminate information on industrial occurrence, signs and symptoms, diagnosis and special tests, if any, for each item in the schedule. The cumbersome steps and procedures involved in claiming compensation are covered separately in this set of reference sheets.

Reprinted 1995 Rs. 75/-

Diseases at Work III - A Story of Workers Struggle on Compensation for Silicosis (English/Hindi)

The third book in the series is an account of the workers' struggle to claim compensation for silicosis, a disease caused by silica dust. The book, which is written in a reflective, story-telling mode, is prepared by one of the leaders of this struggle, who worked for Alembic Glassworks” in Gujarat.

1992, 62pp Rs. 50/-

Dust That Kills Slowly but Steadily (English/Hindi)

This booklet focuses on the major dust-related lung which have become the subject of debate and attention in the context of growing concern over occupational health and safety issues. It covers the diseases resulting due to the dust of silica, cotton, asbestos, mica, coal etc.

1990, 19pp Rs. 10/-
Health at Workplace: Workers Experience (English/Hindi)

This book is the record of workers’ experiences and their struggles on the issue of workplace health and safety. In order to break the most common myth that “workers are careless and do not want to do anything to improve their working conditions”, this book narrates the experiences in the form of 35 case studies. Most of the cases are narrated by the workers themselves.

1992, 124pp          Rs. 40/-

An Untold Story: The Ongoing Struggle of Textile Workers in Ahmedabad (English/Hindi)

This book is the report of the workers’ struggle undertaken for claiming compensation for byssinosis, which afflicted these workers during the tenure of their employment with cotton textile factories in Ahmedabad. The book is intended to provide a detailed account of the struggle, so that, other unions and activists undertake such actions in their respective areas.

1992, 37pp          Rs. 25/-

An Activists Handbook of Occupational Health and Safety (English/Hindi)

This manual provides the latest information available on various types of occupational health and safety hazards. It covers almost all the occupations in India, as well as in South Asia. The range is from traditional industry to high-tech computer and chemical industry; from regular workers to women, children and contract workers.

1993, 223pp          Rs. 150/-
The Danger Within (English)

This is an activity book on occupational health hazards and has been specially designed for use by schools and individuals. The areas include coal mining, textiles, pesticides, child-labour, chemicals, glass, construction workers, municipal workers and occupational health hazards in the office and at home. The book is designed so that the teacher might initiate a process of critically reflecting on social realities, which in turn, will encourage the students to become active agents of change.

1995 pp  Rs. 100/-

Struggle for Justice (English/Hindi)

The series covers various facets of hazards faced by our workers, organised and unorganised. Our laws and safety regulations do not protect them. Many of our workers have organised to struggle collectively for changes at their workplace and their basic human rights. This series is dedicated to them and it includes the following:

A Hospital by the Workers and for the Workers
Chattisgarh Mines Shramik Sangh
Ahmedabad Electricity Company
Kolar Gold Mines
Municipal Mazdoor Union
A Fertiliser Factory

1995  Rs. 15 each  Rs. 75 per set.

Diagnosis of Occupational Diseases (English)

This book gives the basic guidelines for diagnosing occupational diseases. In 1988, PRIA had published “Diseases at Work”, which contained detailed information on the diagnosis of occupational diseases of Schedule III of the Workmen’s Compensation Act (1923) and Employees State Insurance Act (1948). This book was reviewed in 1995 and a document was published after discussions with eminent doctors from all over India. This book includes a list of diseases,
Impairments, Disabilities and their Assessment (English)

This document has been prepared after a year-long study of relevant literature by eminent doctors from all over India. The aim of this book is to evolve a comprehensive document of guidelines and to assess disability as a percentage loss of function of the entire human body in cases of occupational diseases and accidents. A review of the literature of the above subject, published in the last 60 years and case laws related to the subject from all over the world were put together in a “background paper” in 1995. The paper was circulated among doctors and occupational experts and this document was published after discussions and meetings with them.

Employees State Insurance Scheme (English/Hindi)

The Employees State Insurance Scheme, designed to be a workers’ insurance scheme, provides certain benefits and compensation to workers in the event of sickness, employment-related injuries etc. This scheme has come under severe criticism from workers, trade unions and even managers, in some cases, for its inefficiency.

This booklet is written with the aim of providing information on the
various facilities offered by ESI, and the inefficiencies reported in the scheme. Some data has been used from a study conducted by the Society for Participatory Research In Asia (PRIA) in 1995, in the cities of Ahmedabad, Calcutta, Delhi and Mumbai.

1996 Rs. 30/-

Bargaining Disease for Work (English)

Asia is a region of diversity. Besides geographical and cultural differences, the countries have great diversity in terms of their economic and industrial development, political ideologies and systems, administrative styles and work ethics. The only commonality in the whole region which transcends all diversities, is that the issue of occupational and environmental health is given low priority.

This book brings out the state of Occupational and Environmental Health in six countries of South Asian region. It is the outcome of a trip made by PRIA team members to Thailand, Philippines, Taiwan, Republic of Korea, Japan and Malaysia.

Authors : Harsh Jaitli, Vijay P. Kanhere
Year of Publication : October 1997

Price USD 20/- or Rs. 100/-