Cotton Dust Level in Textile Industries and Its Impact on Human

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***Abstract*-** In India, the textile industry contributes substantially to the foreign exchange earned by the country. The textile industry is providing employment opportunities to numerous people in the country. The emphasis on awareness about the environmental concern such as air, water and noise pollution during the processing from fibre to fabric is essential in the present circumstances. Information regarding cotton dust exposure impacts and the control strategies is lacking among textile employers and its management. The main aim of this paper is to provide, dust level in the textile industry and the available air quality standards are discussed to facilitate textile mill employers and management to establish cotton dust control strategies to save their workers from its harmful impacts. The study has been carried out in textile industries located in Tirupur. This study is based on the analysis and monitoring of air pollutants using respiratory dust sampler in work place.

***Index Terms*-** Asthma, Byssinosis, Chronic bronchitis, cotton dust, Pulmonary Diseases, Emphysema, respiratory dust sampler, Particulate matter

I. INTRODUCTION

Textile industry is the second largest industry in the world next to agriculture. In India, the textile industry contributes substantially to the foreign exchange earned by the country. The textile industry consists of a number of units engaged in spinning, weaving, dyeing, printing, finishing and a number of other processes that are required to convert fibre into a finished fabric or garment. The textile industry is providing employment to numerous people in the country. The emphasis on awareness about the environmental concern such as air, water and noise pollution during the processing from fibre to fabric is essential in the present circumstances. There were 1818 mills (non-SSI) in the country as on January 31, 2007 with a capacity of 35.37 million spindles, 4, 48,000 rotors and 69,000 looms. Information regarding cotton dust exposure impacts on workers and its control strategies is missing among textile employers, management and employees. [1]

Cotton dust is defined as dust present in the air during the handling or processing of cotton, which may contain a mixture of many substances including ground up plant matter, fiber, bacteria, fungi, soil, pesticides, non-cotton plant matter and other contaminants which may have accumulated with the cotton during the growing, harvesting and subsequent processing or storage periods.[1]

Any dust present during the handling and processing of cotton through the weaving or knitting of fabrics, and dust present in other operations or manufacturing processes using raw or waste cotton fibers and cotton fiber byproducts from textile mills are considered cotton dust within this definition. [1]

II. MATERIALS AND METHODS

The analysis was carried out in the textile industry in tirupur. The analysis was done in various sections in the mill such as cutting and ironing, knitting and stitching. The experiment was carried out by using an air sampler. The method of measurement is done by gravimetric method. With the analysis from each section, PM2.5 and PM10 were collected. And the duration of the collection of samples is with the time period of 8 hours. The sampling collected is done with process and without process except for knitting sections.

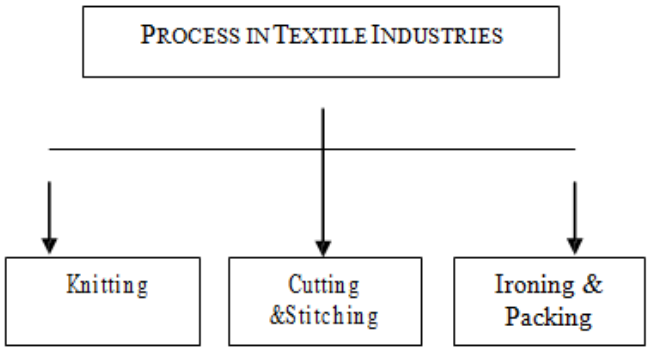


TABLE I
STANDARD METHODS USED FOR TARGET POLLUTANTS

Particulars	$PM_{2.5}$	PM_{10}
Equipments	Respirable dust sampler	Respirable dust sampler
Analytical method	Gravimetric	Gravimetric
Sampling period	8/24 hourly	8/24 hourly
Measuring principal	Gravimetric	Gravimetric
Sampling frequency	Four days continuous	Four days continuous

Sampling

The numbers of samples collected at each zone for a period of 8 hours and the meteorological parameters such as wind speed, wind direction, temperature and relative humidity are also noted.

METHODOLOGY

Method for sampling particulate matter

Total suspended particulate matter (TSPM) comprises of particles above 10 µ (non Respirable particulate matter) and particles below 10 µ (Respirable particulate matter).TSPM present in ambient air is measured by High volume sampling method by using a Respirable Dust Sampler with a cyclone attachment over a period of 8 hours by sucking a known quantity of air through glass fibre filters. The mass of concentration of SPM is computed by measuring the weight of collected matter in known volume of air sampled. [6]

RESPIRABLE DUST SAMPLER

III. CLASSIFICATION OF COTTON DUST

A.According to the type of dust

1. Inhalable Dust

It is a term used to describe dust that is hazardous when deposited anywhere in the respiratory tree including the mouth and nose. [2]

2. Thoracic Dust

It is defined as those materials that are hazardous when deposited anywhere within the lung airways and the gas exchange region. [2]

3. Respirable Dust

Respirable dust is defined as that fraction of the dust reaching alveolar region of the lungs. [2]

According to the size of the particle (Table I1)

TABLE II

Types	Size of particle (µm)
Trash	Above 500
Dust	50 -500
Micro dust	15 -50
Breathable	Below 15

IV. SAMPLING MONITORING

Sampling of the workplace must be done at least every six months to determine the amount of cotton dust in the environment. Measurements must be representative of all employees in the workplace. Sampling will be done in all work areas and on each shift.

Sampling involves measuring with a standard cotton dust monitor called a vertical elutriator (VE) or by an approved similar device. Air is drawn into the vertical elutriator at a specified speed, and particles of 15 microns or smaller is collected on a filter. The particles collected are measured to determine the amount of Respirable dust (dust that can get into the lungs) present is in the work area. It is important to realize that other "dusts," such as starch or oil mist are also collected on the filter and may contribute to the cotton dust levels.

Sampling is done for a period equal to at least three-quarters of the shift (for example, six hours of an eight-hour shift). While sampling is being done, other information is collected that may pertain to the generation of cotton dust. The percent of cotton fiber in the mix; the grade of the cotton and where it was grown; types of yarn being run; and the number and types of machines operating in each area may all affect the amount of cotton dust in the workplace.

Employees will be notified of the findings of cotton dust air sampling once the results have been received. When the results show that an employee is exposed to dust greater than the permissible exposure limit, control measures must be taken to reduce exposure to an acceptable level. Detailed exposure measurement records must be made, and they must be retained for 20 years. [4]

V. PROPERTIES

A.Analysed particulate matter characteristics

1) PM10

Particulate matter is the term for solid or liquid particles found in the air which is of 10 µ size. Some particles are large or dark enough to be seen as soot or smoke. Others are so small they can be detected only with an electron microscope. Because particles originate from a variety of sections their chemical and physical compositions vary widely. Particulate matter can be directly emitted or can be formed in the atmosphere when gaseous pollutants such as SO2 and NOx react to form fine particles.

2)PM2.5

The most important characteristic of particulate matter (PM) is the particle size. Particulate matter that is of 2.5 µ size is denoted as above. This property has the greatest impact on the behavior of particulate matter in control equipment, the atmosphere, and the respiratory tract. Particles of importance in air pollution control span a broad size range from extremely small (0.01 micrometer) to more than 1,000 micrometers. As a frame of reference, a human hair has a diameter of approximately 50 micrometers.

A particle size is usually expressed in terms of its aerodynamic diameter instead of its actual or physical diameter. The chemical composition of the particulate matter is also important. Absorption and heterogeneous nucleation of vapour phase pollutants onto existing particles can create toxic particulate matter. Other characteristics besides size and chemical composition should be considered when selecting an appropriate particulate control device for a gas stream. Other important characteristics of particulate matter in gas streams include stickiness, resistivity and explosiveness.

VI. HEALTH HAZARDS ASSOCIATED WITH COTTON DUST EXPOSURE

Workers exposed to cotton dust laden environment generally become patients of byssinosis.

A.Byssinosis

Byssinosis is a term taken from a Greek word meaning white thread. It is a breathing disorder that occurs in some individuals with exposure to raw cotton dust. Characteristically, workers exhibit shortness of breath and/or the feeling of chest tightness when returning to work after being in the mill for a day or more. There may be increased cough and phlegm production. [3]

Change in the levels of ESR, LDH3 and Histamine may be used as indicators to assess pulmonary dysfunction in the workers those are exposed to cotton dust. It was suggested that the low hemoglobin and poor immunity against diseases may also predispose the outcome pulmonary dysfunction at an earlier stage. Cotton dust extract induces the release of histamine from samples of human lung tissue in vitro. Therefore it is believed that histamine release is responsible for the major symptoms of byssinosis. [3]

Dr. Richard Schilling, a British physician developed a system of grading workers based on their breathing complaints on the first workday of the week. Schillings classification grades byssinosis according to how far it has progressed. [3]

A.1.Schillings classifications are as follows.

- Grade 0 = No complaints of breathing problems.
- Grade 1/2 = Chest tightness and/or shortness of breath sometimes on the first day of the workweek.
- Grade 1 = Chest tightness and/or shortness of breath always on the first day of the workweek.[3]
- Grade 2 = Chest tightness and/or shortness of breath on the first workday and on other days of the workweek.[3]
- Grade 3 = Chest tightness and/or shortness of breath on the first workday and other days as well as impairment of lung function.[3]

TABLE III
Permissible Exposure Limits (PEL) for Cotton Dust for Different Work Areas[3]

TABLE III [5]

DEPARTMENT	PEL (micrograms per cubic meter)
Opening	200
Packing	200
Carding	200
Combing	200
Roving	200
Spinning	200
Winding	200
Warping	200
Slashing	750
Weaving & Knitting	750
Waste house	500

B. Pulmonary Diseases

There is a group of lung diseases called *chronic obstructive pulmonary diseases*. The diseases in the group are major causes of illness and disability among workers.

The most common types of chronic obstructive pulmonary disease are:

_ Chronic bronchitis
_ Asthma
_ Emphysema [3]

1. Chronic bronchitis

Is a disorder characterized by a cough and sputum lasting for three or more months of the year and recurring year after year. [3]

2. Asthma

It is thought to be an allergic type of response that causes airways to swell and become narrow. There is increased mucous causing a wheezy, "whistly" sound to breathing. Usually both chronic bronchitis and asthma improve when the person is removed from the irritation causing this response. [3]

3. Emphysema

It is the destruction of the delicate walls between the tiny air sacks in the lungs. As the walls are destroyed, the air sacks enlarge and the lungs have less ability to supply oxygen to the bloodstream. In emphysema, there is no way to repair the destroyed air sacs. [3]

VII. HEALTH MONITORING

Employees must be monitored if they are to work in an environment containing cotton dust. The environment containing the cotton dust must also be monitored.

A.Medical Monitoring

In any workplace where cotton dust is present there must be a medical surveillance program for all employees exposed to cotton dust. Examinations must be done by or under the direction of a licensed physician. People administering the pul- monary function (breathing) tests must have attended a course approved by the National Institute for Occupational Safety and Health (NIOSH).

Medical examinations are to be provided to prospective employees prior to their initial assignment. As a minimum, the examinations should include:

•A medical history to identify any existing health problems or diseases that may affect breathing.

•A standardized respiratory questionnaire inquiring about such concerns as cough, chest tightness and smoking history.

•A pulmonary function (breathing) test including the forced vital capacity (FVC), the amount of air one can force out after taking a deep breath, and forced expiratory volume in 1 second (FEV1), the amount of air forced out during the first second of expiration.

Test results are compared to a set of predicted tables based on a person's age, height, sex and race. Generally, tests are considered to be within the normal range if they are 80 percent or greater of the predicted value. The initial determinations should be made prior to entering the workplace on the first day worked and after having no cotton dust exposure for at least 35 hours. The pulmonary function tests will be repeated during the shift, at least four hours, but not longer than 10 hours after the first test. These tests are then compared for changes. If there is a decrease of 5 percent or greater on the second after- exposure test, it may indicate a reaction to cotton dust. Each employee will be assigned a byssinosis grade based on his or her response to the respiratory questionnaire.

Follow-up examinations are required annually for all employees exposed to cotton dust. The examinations include an update of the medical history and standardized questionnaire and a repeat of the pulmonary function test preformed both before and after the exposure to cotton dust.

Examination is required every six months for employees who are below the expected normal value when compared to predicted values, or for employees who show a decrease in pulmonary function on the after-exposure test. If the physician feels significant changes have occurred from year to year, or if the worker has complaints about breathing, six-month test- ing will also be done.

Employees who are below 60 percent of the predicted value on their breathing test will be sent to a physician for an evaluation. Employees will be furnished written information on the results of their examination.

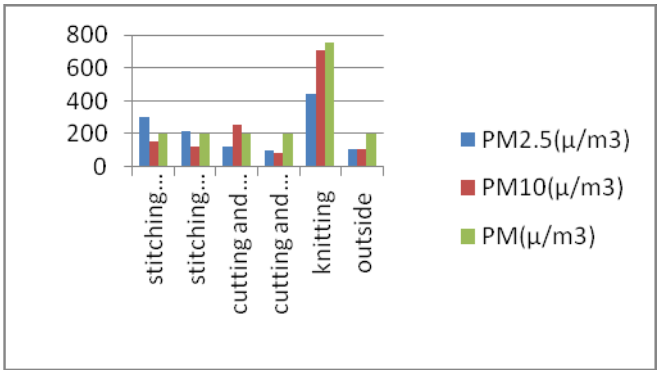
OSHA has not published specific criteria for hiring people to work in a cotton dust environment except to specify an ini- tial examination be conducted. Experience has shown that people who have a history of asthma or other respiratory diseases do not fare well in a cotton dust environment. Many medical specialists recommend that individuals who have a breathing test result below 80 percent of the predicted normal value should not be hired to work in a cotton dust environment. [4]

VIII. .RESULTS AND DISCUSSIONS

TABLE IV

DEPARTMENT	$PM_{2.5}$ (μ/m^3)	PM_{10} (μ/m^3)
Stitching with process	304.318	152.803
Stitching without process	215.303	120.606
Cutting and Ironing with process	126.287	255.075
Cutting and Ironing without process	101.666	86.515
Knitting	446.383	709.621
Outside	109.924	109.240

From this project we have observed that, the workers are exceeding the working limit (8hr to 11hr) and though the working hour is more than the limit for each worker, the value of the pollutant is not accurately exceeding the permissible exposure limit but almost closer whose effects, in case of a continuous exposure might lead to severe negative impacts.



The following recommendations are suggested for controlling the occupational lung diseases caused by cotton dust:

- Periodic health surveillance to be made essential.
- Proper treatment should be given to the affected worker.
- Effective dust control measure to be adopted
- Awareness to be given for the administrators and the Workers.
- Usage of personnel protective equipment should be Strongly advised.
- The management should strictly provide and follow Control technologies and protective strategies.
- The worker should be aware of the effects of cotton dust And exceeding the working limit.[5]

Dust Controls

Often employers can reduce dust levels by adjusting dust control equipment, such as ventilation systems, and by cleaning and repairing the equipment regularly.

An employer's dust control program must include, at a minimum, the following:

(1) Cleaning floors with a vacuum or any other method that cuts down the spreading of dust;

(2) Disposing of dust in such a way that as little dust scatters as possible;

(3) Using mechanical methods to stack, dump or otherwise handle cotton or cotton waste, when possible;

(4) Checking, cleaning, and repairing dust control equipment and ventilation systems.

Employees involved in cleaning must wear respirators. Compressed air may not be used to clean clothing and floors and may only be used to clean equipment if no other methods are possible. If these measures fail to reduce the cotton dust levels below the OSHA limits, employers must try additional engineering controls and work practices.

IX. DISCUSSION

The Project was done with an intention to study the hazardous effects over people working in the textile area. The project was carried out in a location where the above mentioned textile processes happen to be the mere source of income of over 50% of people in the surrounding area.

Hence the results suggest that a continuous exposure to these processes of the textile sector may result in tedious health hazards.

The results also suggest that Particulate matter easily reacts with Aerosols causing the atmosphere more acidic in nature. The effects may be severe some may lead to cardiac failure.

From the above graphical representation we observed that knitting process produces the maximum dust level compared to other process, so we suggest that the preventive measures in the knitting session particularly should be more effective than other sessions.

X. ACKNOWLEDGMENT

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