“Cotton dust” is defined as dust generated into the atmosphere as a result of the processing of cotton fibers combined with any naturally occurring materials such as stems, leaves, bracts, and inorganic matter which may have accumulated on the cotton fibers during the growing or harvesting period. Any dust generated from the processing of cotton through the weaving of fabric in textile mills and dust generated in other operations or manufacturing processes using new or waste cotton fibers or cotton fiber by-products from textile mills is also considered cotton dust.

Byssinosis is an industrial disease due to breathing dust from vegetable fibers such as flax, hemp, cotton dust or sisal while in the workplace. The textile industry workers are at risk of developing byssinosis due to workplace is not adequately ventilated, whether to dust or endotoxins cause byssinosis.

Cotton dust can be classified in four types according to the size of particle. Trash (Above 500 μm), Dust (50-100μm), micro dust (15-50 μm) and breathable dust (below 15 μm)

Cotton dust may cause adverse health effects through inhalation. Short term exposure to cotton dust has caused bronchitis and acute byssinosis a reversible respiratory disease produced by inhalation of cotton dust. Chronic exposure has caused lung airway obstruction (which reduces ventilatory capacity) and has led to disability and premature death. A direct relationship has been observed between the total concentration of cotton dust exposure and the rate of development of byssinosis. Among workers exposed to cotton dust, cigarette smokers have an increased risk of developing byssinosis.

Byssinosis is an industrial disease due to breathing dust from vegetable fibres such as flax, hemp, cotton dust or sisal while in the workplace. The textile industry workers are at risk of developing byssinosis due to workplace is not adequately ventilated, whether to dust or endotoxins cause byssinosis.

Cotton dust causes inflammation damaging the normal structure of the lung and release of histamine, which constricts the air passages. Breathing becomes difficult - over a period of time due to accumulation in the lung, producing a typical discoloration known as brown lung disease.
The Departmental Committee on Compensation for Cardroom Workers adopted in 1939 the term ‘byssinosis’. Since then it has appeared extensively in literature dealing with respiratory disease of textile workers.


**Synonyms:**
Cotton worker’s lung; Cotton bract disease; Mill fever; Brown lung, Monday fever

http://www.umm.edu/ency/article/001089trt.htm

**Etiology**
Byssinosis occurs almost entirely in workers who contact unprocessed, raw cotton, especially those who are exposed to open bales or who work in cotton spinning or in the card room. Byssinosis can occur after acute exposure but usually occurs in workers with a history of chronic exposure. Evidence suggests that some agent in the cotton bract leads to bronchi-constriction. Although bacterial endotoxin is a likely cause, the absence of similar symptoms in other settings in which workers are exposed to endotoxin leaves some uncertainty. Chronic bronchitis symptoms are common among people exposed to cotton dust.

http://medicalmarijuana.com/experts/expert/title.cf m?artID=709

Several years of exposure to cotton dust are needed before byssinosis develops, and workers with lower grade disease usually recover completely upon leaving the industry or moving into an area with less dust. Persons with mild byssinosis have a “Monday feeling” of chest tightness and shortness of breath on the first day of work after a weekend or holiday. As exposure continues, this feeling persists throughout the week, and in advanced stages, byssinosis causes chronic, irreversible obstructive lung disease.

http://www.britannica.com/EBchecked/topic/87102/ byssinosis

Byssinosis a form of pneumoconiosis due to prolonged inhalation of cotton dust, has long been recognized as a cause of ill health among British cotton-mill workers. In 1936, C. Prausnitz and co-workers, under the auspices of the British Medical Research Council, published an account of their extensive investigations into the causes of respiratory disease in this industrial group. A brief review of this work as follows.

Sickness caused by respiratory disorders is frequent in cotton mill operators, particularly those working in departments in which there is a continuously high content of cotton dust in the air. Many operators working in such departments experience a typical illness, referred to as “stripper’s asthma” or “cotton-mill fever,” an insidious disease characterized initially by evidence of upper respiratory irritation with moderate fever. The first attack soon subsides, but with continued employment in this type of work a dry irritating cough and attacks of breathlessness develop, with a sense of constriction in the chest. These symptoms are aggravated on return to work on Mondays after a week-end of absence from the mill. In a period of years, symptoms become more severe; “Monday-morning fever” continues into later days of the week, with aggravation of symptoms. The cough grows worse, becoming spasmodic, with production of small quantities of sticky, tenacious sputum. If the affected person quits the mill before symptoms become too severe and enters some type of out-of-door work, these disappear and health is regained. If, however, he remains in the same type of employment, he becomes progressively worse, with a prospect of invalidism with emphysema, bronchitis, and ultimate cardiac failure. Fletcher, (co-worker of Prausnitz,) examined radiographically 100 persons with “mill fever.” He describes the appearances as those of chronic bronchitis with associated emphysema; there were no particular roentgen features specific for the disease.

http://radiology.rsna.org/content/46/1/46.extract
Signs and symptoms of exposure

Short term (Acute): exposure to cotton dust can produce a feeling of chest tightness, coughing, wheezing, phlegm, weakness, fever, chill, and breathing difficulty (dyspnea). These symptoms can disappear following removal from exposure (during brief periods away from work) and can reappear following reexposure.

Long-term (Chronic): Exposure to cotton dust can cause permanent and disabling breathing difficulties that include chronic bronchitis with emphysema.

http://www.cdc.gov/niosh/docs/81-123/pdfs/0152.pdf

Diagnosis

The disease can be diagnosed as follows

History: Symptoms include tightness in the chest, wheezing, coughing, and shortness of breath when exposed to the dust produced during processing of cotton, flax, hemp, or sisal. The symptoms usually lessen or go away when the worker goes home. Symptoms are more pronounced on the first day after returning to work following a weekend or vacation. They gradually lessen with repeated exposure throughout the week. In chronic byssinosis, symptoms persist even when the individual is away from work.

Physical exam: Auscultation (listening to the chest with a stethoscope) may reveal wheezing sounds.

Tests:

Pulmonary function tests using spirometers and peak flow meters evaluate lung volume and capacity and help identify and measure any obstructions or restrictions (or combination of both) in air flow through the lungs, thus confirming the presence of lung disease.

Arterial blood gases (ABG) and oxygen saturation testing assess the efficiency of gas exchange in the lungs by showing its rate of absorption into the blood.

Chest x-rays and CT scans may be helpful in ruling out other lung disorders. 

Although inhaling cotton dust was identified as a source of respiratory disease more than 300 years ago, byssinosis has been recognized as an occupational hazard for textile workers for less than 50 years. More than 800,000 workers in the cotton, flax, and rope-making industries are exposed in the workplace to airborne particles that can cause byssinosis. Only workers in mills that manufacture yarn, thread, or fabric have a significant risk of dying from this disease.

http://medicaldictionary.thefreedictionary.com/byssinosis

Complications:

Lung scarring: Damage to the lung tissue can cause scarring of the lung tissue. Small scars generally cause no problems but large or widespread scarring can affect breathing. Excessive lung scarring can lead to thickening and stiffening of the lung tissue which can make breathing more difficult. Scar tissue can also be a result of damage due to cancer.

Complications and sequelae of Byssinosis from the Diseases Database include:

Bronchospasm

http://www.rightdiagnosis.com/b/byssinosis/intro.htm

Medical Monitoring:

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 (FEV.), the amount of air forced out during the first second of expiration.

Environmental Exposure 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 should be done in all work areas and on each shift.
- Sampling is done for a period equal to at least three-quarters of the 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.

Vertical Elutriator:

It is used to monitor employee exposure to cotton dust in the workplace. Air is drawn into the vertical elutriator at a specified speed, and particles of 15 microns or smaller are collected on a filter. The particles collected are measured to determine the amount of respirable dust (dust that can get into the lungs) there 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.

Occupational exposure limit for cotton dust

<table>
<thead>
<tr>
<th></th>
<th>Exposure limits μg/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>OSHA PEL TWA (time-weighted</td>
<td>200 (yarn manufacturing and cotton washing)</td>
</tr>
<tr>
<td>average)</td>
<td>750 (Slashing and weaving)</td>
</tr>
<tr>
<td></td>
<td>500 (Textile mill waste house operations and lower grade washed cotton in yarn manufacturing)</td>
</tr>
<tr>
<td></td>
<td>1,000 (Waste recycling and garneting)</td>
</tr>
<tr>
<td>NIOSH REL (Recommended Exposure Limit)</td>
<td>&lt;200</td>
</tr>
<tr>
<td>ACGIH TLV</td>
<td>200</td>
</tr>
</tbody>
</table>

http://www.cdc.gov/niosh/docs/81-123/pdfs/0152.pdf
**Treatment:**

The most important treatment is to stop “being exposed” to the dust. Reducing dust levels in the factory (by improving machinery or ventilation) will help in preventing Byssinosis. Some people may have to change jobs to avoid further exposure.

Medications used for asthma, such as bronchodilators, will usually improve symptoms. Corticosteroids are prescribed in more severe cases. Avoid smoking, xenobiotics (panmasala, tobacco), alcohol consumption as they are important for people with this condition. Breathing treatments, including nebulizers, are prescribed if the condition becomes long-term. Home oxygen therapy may be required if (blood /oxygen) levels are low. Physical exercise programs, breathing exercises, and patient health education programs are often very helpful for people with a chronic lung disease.

**Prevention:**

* Measures like face masks and dust control may reduce the chances for byssinosis
* Smoking should be avoided.
* Exposure to the dust should be discontinuing.
* Ventilation and exhaust hoods need to be used.

**Permissible exposure limits for cotton dust for different work area**

<table>
<thead>
<tr>
<th>Area</th>
<th>PEL(μg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening</td>
<td>200</td>
</tr>
<tr>
<td>Picking</td>
<td>200</td>
</tr>
<tr>
<td>Carding</td>
<td>200</td>
</tr>
<tr>
<td>Combing</td>
<td>200</td>
</tr>
<tr>
<td>Roving</td>
<td>200</td>
</tr>
<tr>
<td>Spinning</td>
<td>200</td>
</tr>
<tr>
<td>Winding</td>
<td>200</td>
</tr>
<tr>
<td>Warping</td>
<td>200</td>
</tr>
<tr>
<td>Slashing</td>
<td>750</td>
</tr>
<tr>
<td>Weaving</td>
<td>750</td>
</tr>
<tr>
<td>Wastehouse</td>
<td>500</td>
</tr>
</tbody>
</table>

**Operations and methods of control for cotton dust**

<table>
<thead>
<tr>
<th>Operations</th>
<th>Methods of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>During carding operations, mixing and blowing operations, bale breaking,</td>
<td>Process enclosure, local exhaust ventilation, personal protective equipment</td>
</tr>
<tr>
<td>manufacturing of cotton yarn, and handling of cottonseed in the extraction of cotton-</td>
<td></td>
</tr>
<tr>
<td>seed oil</td>
<td></td>
</tr>
<tr>
<td>During cotton batting operations and weaving of textiles containing cotton yarn</td>
<td>General dilution ventilation</td>
</tr>
<tr>
<td>During raw cotton ginning, bale pressing, and harvesting</td>
<td>Local exhaust ventilation, personal protective equipment</td>
</tr>
</tbody>
</table>

**Dust level reported in different countries in textile mill**

<table>
<thead>
<tr>
<th>Country</th>
<th>Dust level (mg/m³)</th>
<th>Section</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mill A</td>
<td>6.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mill B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turkey (2002)</td>
<td>0.095 -0.413</td>
<td></td>
<td><a href="http://www.ncbi.nlm.nih.gov/pubmed/11844963">http://www.ncbi.nlm.nih.gov/pubmed/11844963</a></td>
</tr>
</tbody>
</table>
WHO Grading system

**Respiratory Tract Irritation (RTI)**

- **Grade 0**: No symptoms
- **Grade RTI-1**: Cough associated with dust exposure
- **Grade RTI-2**: Persistent phlegm (i.e. on most days during 3 months of the year)
- **Grade RTI-3**: Persistent phlegm initiated or made worse by dust exposure either with exacerbation of chest illness or persisting for 2 years or more

**Lung function**

- **No effect**: FEV\(_1\)^b 80% of predicted value^c
- **Mild effect**: FEV\(_1\)^b 60-79% of predicted value^c
- **Moderate effect**: FEV\(_1\)^b less than 60% of predicted value^c
- **Severe effect**: A decline of 20% or more in FEV\(_1\) during the work shift

**Acute changes**

- A consistent^a decline of less than 5% or increase in FEV\(_1\) during the work shift
- A consistent^a decline of 5-10% in FEV\(_1\) during the work shift
- A consistent^a decline of 10-20% in FEV\(_1\) during the work shift

**Chronic changes**

- Byssinosis
  - **Grade B1**: Chest tightness and/or Shortness of Breath on most of first days back at work
  - **Grade B2**: Chest tightness and/or Shortness of Breath on the first and other days of the working week

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^a A decline occurring in at least three consecutive tests made after an absence from dust exposure of two days or more.

^b Predicted values should be based on data obtained from local populations or similar ethnic and social class groups.

^c By a pre-shifted test after an absence from dust exposure of two days or more.

The possible mechanisms may be viewed from two aspects: (1) assessment of the biologic functioning of the material inhaled, including its allergenic potential, vasoactive amine content, or capacity to release histamine, activation of complement, or pathology induced in the experimental animal, etc.; and (2) comparison of the disease and its suspected etiologic agent with other organic dust diseases in which active components and mechanisms have been more fully defined.

Work literature scanning show out of at least six hypotheses three have arisen to account for byssinosis.

1. Inert dust reaction This assumed that there was a narrowing of the airways as a reflex response to mechanical irritation. However, cotton mill dust produces a maximum response at 1/30 that of coal dust, which is considered to be a standard inert dust. The effect of the cotton mill dust lasted a few days, whereas the effects of inert dust, if any, resolved within a few hours. Also, washed cotton mill dust did not evoke FEV\textsubscript{1} changes.

2. Direct contractor activity Although the cotton plant contains detectable histamine, 5-hydroxytryptamine (serotonin), and a direct-acting smooth-muscle contractor, these concentrations are too low to produce bronchoconstriction in man for the amounts of cotton dust inhaled over a shift.

3. Immediate allergic reaction Although there is a fall in FEV\textsubscript{1} after exposure to cotton mill dust, it is unlikely to be due to IgE-mediated hypersensitivity, since asthma and byssinosis present dissimilar clinical patterns; there is an even distribution of byssinosis among nonatopics and atopics; byssinosis may affect up to 80 percent of people exposed; and byssinosis progresses to respiratory disability in the absence of further exposure. These differences have been reviewed in depth by Schilling.

The remaining three hypotheses require further development.

4. Histamine release by cotton mill dust There is a wealth of information that cotton mill dust, extracts of this dust, and extracts of cotton plant bract can cause histamine release. Inhalation challenge of normal subjects with cotton dust results in a fall in FEV\textsubscript{1} and a rise in airways resistance with no change in transfer factor.\textsuperscript{3} Antihistamine prevents the fall in FEV\textsubscript{1}. An increase in the histamine metabolite MeIAA (methyl imidazole acetic acid) was observed in these subjects. That the eliciting material was soluble was shown by the lack of response to inhalation challenge with cotton mill dust washed overnight at 40°C with 20 percent aqueous ethanol. (The necessity for a volatile bacteriostat was apparent from studies when water only was used for overnight washing, resulting in a marked rise in both bacterial counts and intrinsic histamine levels).

Similarly, in vitro studies have shown extracts of cotton mill dust to cause the release of histamine from pig platelets. Cotton plant bract also caused histamine release from pig platelets, and a histamine-releasing compound defined as an amino-polysaccharide-protein complex has been isolated. A purified extract from cotton bracts also induces airways constriction in human subjects.

5. Antigen-antibody hypothesis Massoud and Taylor\textsuperscript{5} reported that extracts of cotton mill dust or cotton plant bract produced lines of precipitation with sera from byssinotic patients; however, all human sera reacted, except at a lower titer. In later work,\textsuperscript{6} a purified polyphenolic compound 5,7,3,4-tetrahydroxyflavan-3′4′-dihol (THF) was identified as the precipitating agent, and more sophisticated serologic tests confirmed the original findings. They also showed that titers generally declined during the week and rose over a weekend with cessation of exposure. In a double-blind trial, inhalation challenge with
THF induced symptoms of byssinosis in five of six byssinotic subjects but no symptoms in nine exposed byssinotic cotton workers and eleven unexposed controls, and all saline placebo results were negative. It was originally suggested” that antigen-antibody complexes led to the pathology and pathophysiology of byssinosis, presumably in a manner akin to immune complex disease, i.e., complement fixation, polymorph attraction, and hydrolase release causing tissue damage.

6. **Endotoxin activity.** Originally suggested by Pemis et al, later Cavagna et al showed the inhalation of 80 µg purified Escherichia coli endotoxin to produce a fall in FEV₁ in two of eight normal subjects without any associated rise in body temperature. The levels of endotoxin were similar to those a worker would experience in a cotton mill. Experimental rabbits exposed to E coli endotoxin or cotton extract daily from Monday to Friday for 20 weeks showed antibodies against either E coli endotoxin or cotton extract, respectively, and when given an inhalation challenge, both groups produced an increase in pulmonary resistance greater than that observed in control animals challenged with the same material. Rylander has extended this work and demonstrated that the prevalence of byssinosis correlates better with endotoxin activity in respirable cotton dust than with dust levels. https://journal.publications.chestnet.org/article.asp?articleid=1052818