V. DEVELOPMENT OF STANDARD

Basis for Previous Standards

Roach and Schilling [85] in 1960 published byssinosis prevalence vs total-dust concentration data which indicated a negligible prevalence below 1 mg of dust/cubic meter of air. Their recommendation was that a target concentration of 2.5 mg/cu m be adopted. According to their data, the prevalence of byssinosis (Grades 1 and 2) below total dust levels of 2.5 mg/cu m was about 5%, and that of all grades 20%.

In 1964 the Threshold Limits Committee of the American Conference of Governmental Industrial Hygienists (ACGIH), [148] on the basis of Schilling's work, proposed a tentative TLV for cotton dust (raw) of 1.0 mg/cu m. This became a recommended value in 1966. [149] In its 1971 documentation of TLV's, [150] ACGIH noted the work of Bouhuys [151] in American mills who found "17 to 28% byssinosis at cotton dust levels averaging close to the recommended limit of 1 mg/cu m (ie 1.5-1.77 mg/cu m). In view of these findings, a ceiling limit of 1 mg/cu m of raw cotton dust (containing bract) that permits no excursions above this limit would seem more appropriate."

In a report on the Second International Conference on Respiratory Disease in Textile Workers, held in Alicante, Spain, September-October 1968, Bouhuys, Gilson, and Schilling [152] commented: "The standard of 1 mg/cu m for the threshold limit value of cotton dust (i.e. total dust).... may have to be revised downward in the light of recent findings that there are important exceptions to the dose-response relationship on which this proposal was based. Revision of the TLV in terms of respirable dust rather than total dust should also be considered."

This comment probably resulted in part from the report of Molyneux and Berry [125] at the conference, in which they concluded that:

"4. Although the present hygienic standard of 1 mg/cu m is reasonably formulated as a practical means of assessing the cardroom environment, its reference to total dust alone would appear to be unrealistic. The correlations described in this study suggest that respirable and medium fractions have a greater biological significance than was originally anticipated.

"5. The dust produced by the cardroom processes of medium and coarse mills is qualitatively similar but ring frames appear to produce dust which has a lower toxicity per unit mass than that of other processes in the same type of mill. This casts doubt upon the use of one hygienic standard for all mill processes."

Roach [153] noted that a 1.5% prevalence of byssinosis had been reported in workers exposed to concentrations of total dust below 0.5 mg/cu m and 2.8% exposed at between 0.5 and 1.0 mg/cu m. He suggested in 1970 that a concentration of <0.4 mg/cu m of dust excluding fly be considered negligible, and that concentrations between 0.5 and 1.4 mg/cu m be considered low, producing an estimated risk of <2% of causing the least demonstrable permanent effects on the lungs.

The British Occupational Hygiene Society Committee on Hygiene Standards, Sub-committee on Vegetable Textile Dusts, presented its recommendations on cotton dust in 1972. [126] It felt that a reasonable objective would be to reduce dust concentrations to a level where no more than 4% of the workers develop byssinosis Grade II (chest tightness or difficulty in breathing on the first and other days of the working week), and concluded:

"1. The total concentration of dust, less fly, is directly related to the prevalence of byssinosis of all grades and the relationship is similar for processes involving medium and coarse cotton.

"2. Dust levels (less fly) below 0.5 mg/cu m are associated with the occurrence of byssinosis symptoms of less than 20%.... The data from Table 2 [Table XII-11 in this document] suggest that this prevalence should not be associated with one of grade II symptoms higher than about 4%. The reasons for the higher prevalence of grade II symptoms found by Molyneux and Tombleson [ref 13 in this document] have already been discussed .... Since it is unlikely that all workers with grade II symptoms will be permanently affected, a maximum average dust concentration of 0.5 mg/cu m, less fly, should achieve the objective of reducing the risk of permanent effects to a very low level.

"3. Dust levels in excess of 1.0 mg/cu m may produce much higher prevalence of byssinosis and the disease may occur in susceptible individuals within the first 4 years of exposure.

"4. Waste operations should be considered in the high risk category as should spinning operations if they are not physically separated from the cardroom."

The committee noted, however, that Molyneux et al [13,125] found approximately 6% byssinosis (Grade II) at the recommended limit of 0.5 mg/cu m (fly-free). The Committee presented combined data indicating an overall ratio of less than one case of byssinosis (Grade II) per five cases byssinosis (all grades) as shown in Table XII-11.

In 1972 the ACGIH Threshold Limits Committee [154] proposed changing the TLV for raw cotton dust from 1 mg/cu m total dust to 0.2 mg/cu m of lint-free dust, as measured by the vertical elutriator based upon the work of Merchant et al. [18]

The Occupational Safety and Health Administration standard is 1 mg/cu m of cotton dust (raw) based on the ACGIH TLV of 1968 [29 CFR Part 1910.93, published in the Federal Register, volume 39, page 235411, dated June 27, 1974].

Basis for Recommended Environmental Standard

Several problems complicate the selection of a standard for occupational exposure to cotton dust. By far the most important single problem is that identity of the agent responsible for byssinosis and other respiratory ailments of cotton workers is unknown.

It has been shown [85] that the compositions of fine, medium, and coarse dusts in cotton mills vary, with cellulose predominating in the coarse fraction, while organic trash and minerals are concentrated in the medium and fine fractions. Berry and co-workers [65] found marked differences in byssinosis prevalence among different occupations, even when standarized for fine dust concentrations, length of exposure, and smoking habits. Others have failed to find significant correlation between byssinosis prevalence and dust concentration. [14,50,58,62] These findings could be due to the fact that the quantities of active agent in the dusts from different operations and mills may be substantially different. There appears to be no recognition of general differences due to the geographical location of the source of the cotton, although such variation has been reported. [87]

Preferably a limit for a noxious agent in the environment should be based on the concentration of active material. In the case of cotton dust there have been almost as many theories of the identity or nature of the responsible ingredient as investigators of the problem. Byssinosis has been reported as probably being due to a bacteria or fungi, [60] to an endotoxin of bacterial origin, [75] a condensed polyphenol, [90] a polysaccharide, [86,87] methyl piperonylate, [89,143] or to proteolytic enzymes. [92,93]

With the exception of proteolytic enzymes, no serious suggestion has been made that the health standard for cotton dust be based on the content or concentration in the air of the suggested causative agent. Although Tuma et al [93] did not suggest a limit based on the concentration in the air of proteolytic enzymes, their data would indicate a value of 0.2 to 0.4 milliunits per cubic meter (in fine dust) of chymotrypsin-like enzymes.

There is a precedent for basing health standards on airborne enzymes in the case of subtilisin, the enzyme added to some detergents. The proposed TLV for this substance is 60 nanograms per cubic meter of air [155]; in comparison, the TLV's for rhodium (soluble) and beryllium are 1,000 and 2,000 nanograms (1 and 2 μg) per cubic meter of air, respectively. In order to use a standard such as the one for subtilisin, which may require difficult and sophisticated analytical procedures, it is not always necessary to determine the etiologic agent in every air sample. If its concentration in the dust of a given process or area can be shown to be relatively constant, routine monitoring can be carried out by gravimetric determination of dust, appropriately sized.

Such a procedure could be utilized not only for proteolytic enzymes but for any of the other active agents in the dust, provided they could be quantitatively determined in dust samples sized in accordance with the air sampling procedure used.

According to Silverman and Viles, [156] cotton mill dust consists of three main components: cotton, inorganic material, and organic trash. A fourth component, starch, was found in some samples and was attributed to added sizing. The organic trash fraction contained nitrogen and carbohydrates, but appeared to be best characterized by its nitrogen content.

Roach and Schilling [85] made a similar classification in which they recognized cellulose, minerals, and protein as the major components. They found the best correlation between dust concentration and byssinosis to be with protein in medium-sized dust (7 μm to 2 mm). They found cellulose to be concentrated in the coarse fractions (85 - 94% cellulose) while minerals and proteins predominated in the medium and fine fractions.

Noweir [86] however reported that visual inspection of field data indicated a higher correlation of the incidence and severity of byssinosis with the concentration of carbohydrates than with that of protein in the airborne dust, a confirmation of the laboratory findings of Nicholls. [88]

No tabular or graphic presentation or correlations between different concentrations of protein or carbohydrate dust in the air of cotton mills and the prevalence of byssinosis appear to be available.

Using the analytical results of Roach and Schilling [85] it would be possible to recalculate the dustiness-prevalence data, at least for certain operations, in terms of the protein content of the dust. Since only a few investigators have analyzed dust for protein, however, such calculations would be dependent on assumptions as to dust composition and would add little to the data currently available, which are in terms of weight of dust, sized by various procedures.

Since there does seem to be a relationship between the activity of the dust and its trash or bract content, [8] analysis for these materials in airborne dust might seem to promise a better measure of hazard than determination of the weight of the dust. Such a measurement could be made by determination of the nitrogen content [156] or indirectly by measurement of the amount of cellulose and mineral matter. The biological activity of the dust could be assumed to be proportional to the percentage of nonmineral noncellulose matter. Again it would not be necessary to analyze each air sample for these generic components, but only to establish the average composition of dusts, of appropriate particle size, associated with specific operations or areas.

It is apparent that, if a standard for cotton dust exposure is to be established on the basis of available data, there is little alternative to specifying it as weight of dust per unit volume of air excluding as far as possible the fraction which seems to have little biological effect, namely the fly or lint. This fraction can be removed by a fine wire mesh, the usual British practice, or rejected by a suitably designed elutriator, or other appropriate means.

In common with other particulates, especially those whose main effect is on the respiratory system, the size of the particles of cotton dust as well as the number or quantity in the air, is a major consideration in assessing their potential biological effect. Various investigators have measured the total weight of airborne cotton dust in a given volume of air and at the same time have determined the prevalence of byssinosis in the mill or the department where the dust concentration was measured. [11,13,14,18,20,49,50,56,58,85,98,119-121,125] Many of these studies also included determinations of the concentrations of medium and fine (respirable) fractions. A few measured in addition to total dust only the fine fraction. [98,120,121] Others, using fine wire screens or cyclones to remove the coarse particles, determined only the fly-free dust (approximately the medium and fine fractions combined). [14,50,58,123] The vertical elutriator was employed in the investigation of Merchant et al, [18] collecting dust below 15 μm aerodynamic diameter, while Imbus and Suh [17, written communication from Imbus in 1972] used the same principle to collect finer dust (7 μm and smaller).

Although Roach and Schilling [85] found in 1960 a correlation between total dust concentration and byssinosis prevalence, more recent evidence has suggested that fine (respirable) particles, or fly-free dust (medium plus fine fractions), or those below aerodynamic diameter of 15 μm, are more significant. In 1962 McKerrow et al [129] reported: "It is concluded that the fine fraction (under 7 μm) of cotton mill dust produces changes in respiratory function and may be alone responsible." In 1970, however, Roach [153] based his classification of dust exposure on fly-free dust, ie, excluding the portion which would be caught on a 2-mm wire mesh or rejected by an elutriator designed to separate 50% of 15 μm diameter unit density spheres. Thus it seems to be that determination of fly-free dust, as practiced generally in England where the fly is removed by a 2-mm wire screen, [123,153] and dust below 15 μm aerodynamic diameter, as measured by a suitably designed and operated vertical elutriator, are the most practical measures to estimate cotton dust concentrations of hygienic significance. [18,124,157]

Although some authorities [153] consider that these two sampling methods yield very similar results, others [SG Luxon, written communication to NIOSH, 1972] have estimated that the elutriator collects about 40% less dust than the filter preceded by 2-mm wire screen.

In establishing standards for harmful agents in the work environment, the ideal solution is to select a level at which no detectable harmful effect occurs in any individual. This usually poses no problem with substances which are of low toxicity, or have physical and mechanical properties such that their presence in the air in significant quantities is improbable. In fact it is believed that this goal has been achieved in many of the standards in effect or proposed for substances of substantial or even high toxicity.

With materials which characteristically cause serious illness, disability, or death, the level should be set at a point where there is no detectable incidence of the disease (or increase in incidence of a non-specific disease or condition), and where a substantial safety factor would be provided.

On the other hand, if the effects of the agent are relatively mild, and in particular, completely reversible, one might argue that it is acceptable to set a limit at which a small percentage of workers will be affected to some degree, provided there is evidence that no permanent injury will eventually develop.

The effects of cotton dust do not appear to neatly fit any of these categories. There is evidence that in fact a certain percentage of workers affected with this condition may in time suffer permanent impairment of respiratory function, beyond that normally resulting from increased age and inhalation of cigarette smoke and other pollutants. [60] The ratio of prevalence of Grade 1/2 byssinosis to Grade 2 byssinosis is generally given as about 5 to 1. [126]

The British Occupational Hygiene Society (BOHS) [126] considers concentrations of cotton dust, less fly, below 0.5 mg/cu m of air to be acceptable and have established this limit as a standard for cotton dust in England. The fly, or lint, is removed by 2-mm mesh of 0.2-mm diameter wire. Concentrations in this range are reportedly (see Tables XII-10 and XII-11) associated with an occurrence of byssinosis symptoms (all grades) of <20%, and a prevalence of grade 2 symptoms of <4%.

Fox et al, [123] however, concluded that at this concentration (0.5 mg/cu m) only 10% of workers would have symptoms after 40 years' exposure. Their findings are in some disagreement with Berry and associates, [65] whose data predict a byssinosis prevalence of 30-60% for various preparation area workers after 40 years' exposure at 0.5 mg/cu m of fly-free cotton dust. Their results for ring spinners agree well with the findings of Fox and co-workers [123] for all categories of workers.

In contrast, in a 1974 written communication to NIOSH, Imbus maintains that the data published by him and his co-workers, [17] although not adjusted for length of exposure, are in general agreement with the results obtained by Fox et al [123]. Preparation area workers exposed at <0.5 mg/cu m had a prevalence of <10% byssinosis, while for yarn areas a prevalence of about 3% was found in over 1,000 employees exposed at 0.3 mg/cu m or less of <15 μm dust.

Merchant et al [18] however found a prevalence of 7% byssinosis (10% for smokers) in cotton preparation and yarn workers exposed at a concentration of 0.1 mg/cu m, and around 25% at the 0.5 mg/cu m level. If only carding workers had been included, higher prevalences would probably have been observed since it has been noted that ring spinners show a lesser prevalence than those engaged in other yarn preparation processes. [17,125]

Merchant et al [18] recommended that an environmental limit be set at 0.1 mg/cu m, as measured by the vertical elutriator.

Even though the limit of 0.1 mg/cu m recommended by Merchant et al [18] does not provide, according to their own data, complete protection against symptoms of byssinosis, it is so low that its application could involve some problems in interpretation due to possible interference from background dust. The Environmental Protection Agency national primary and secondary standards for particulate matter in ambient air are 75 μg (0.075 mg)/cu m and 60 μg (0.060 mg)/cu m respectively, as published in the Federal Register, volume 36, pages 8186-87, April 30, 1971. This would mean that, in an area where atmospheric pollution was present, even though the limit was not exceeded, the concentration of dust and fume in the outside air could approach the 0.1 mg/cu m suggested limit for dust inside cotton mills.

However, one would expect that a portion of the atmospheric pollution outside the mill would be made up of dust from the mill, thereby reducing the effect any outside particulate matter may have upon air samples taken inside the mill.

There remains the TLV proposed by the ACGIH [155] of 0.2 mg/cu m of dust determined by the vertical elutriator, so designed and operated that half the <15 μm diameter unit density spheres would be separated. [153] The dust so collected is frequently designated as <15 μm or lint-free dust. This limit is twice that recommended by Merchant et al, [18] and two-thirds the BOHS [126] limit, if the estimate [supplied by SG Luxon in a written communication to NIOSH in 1972] that 0.3 mg/cu m of cotton dust collected with the vertical elutriator corresponds to 0.5 mg/cu m by the British sampling method for fly-free dust is correct. Interference from background dust would obviously constitute a less serious problem with 0.2 mg/cu m than with a 0.1 mg/cu m limit.

A compilation of the reported cases of byssinosis, all grades, (see Table XII-6), which have been correlated with measured dust exposure, indicates about 1,980 cases. [11,14,18,49,50,65,85,93,119,120,122, 123,125,126, a 1972 written communication from HR Imbus] The exposure data have been obtained by various sampling procedures, but results are given in terms of total dust; coarse, medium and fine (respirable) dust; fine dust (<7 μm); medium dust (7 μm to 2 mm) meaning it passed through a 2-mm wire mesh but not through a Hexhlet horizontal elutriator; fly-free or lint-free dust; or <15 μm dust. In a few cases cyclones were utilized to separate coarse particles.

In the majority of cases, the coarse dust constituted between 50 and 80% of the total, [11,14,58,62,124,125] although percentages as low as 11% [50] and as high as 85% [58] were reported. Concentrations of fine dust ranged from 3% [124] to 57% [120] of those of total dust. Some investigators [49,56,62,85,124] found two to five times as much medium dust as fine, but others [11,13,125] reported about equal amounts in the medium and fine fractions. In general, dusts from carding processes were finer than those from other operations.

Based on the assumption that, where actual data are not given, the fly constituted 70% of the total dust, and the medium sized and fine fractions were present in equal quantities, it is possible to estimate how many of the 1,980 cases of byssinosis were associated with concentrations of fly free or <15 μm dust below 0.25 mg/cu m. Over 1,880 of the cases occurred in areas or plants where average concentrations were above this level. The majority of these reports [13,14,49,50,58,65,119-121,123,125] did not indicate any definite exposures to concentrations below 0.25 mg/cu m. Of the approximately 85 cases which had exposures below 0.25 mg/cu m, 58 were recorded by Merchant et al. [18] Six are included from the early paper of Roach and Schilling, [85] and 11 from Lammers et al, [98] consisting of spinners in English and Dutch mills where average fine dust concentrations of 0.03 and 0.1 mg/cu m, respectively, were found. None of the 13 cases mentioned by Fox et al [123] exposed at concentrations below 1 mg/cu m (and averaging about 0.5) are used. The 23 cases recorded by Imbus and Suh [17, written communication from HR Imbus, 1974] had exposures below 0.2 mg/cu m.

Of 64 cases associated with dust concentrations below 0.25 mg/cu m reported by two investigators, [18,85] 13, [18] or 20%, were diagnosed as Grade 2 or 3. In comparison 158 (21%) of 749 cases with heavier exposure were classified as Grade 2 or 3.

Under ordinary circumstances, the above data would provide strong justification for a standard of 0.25, or at least 0.2 mg/cu m. The almost unanimous conclusion that there is a linear dose-response relationship, at least in the lower concentrations, [126,157] and the finding by Merchant et al [18] of cases of byssinosis can be associated with dust levels as low as 0.05 mg/cu m, however, cannot be ignored.

If some of the dose-response data are plotted linearly, notably those of Molyneux and Berry [125] and Imbus and Suh, [17, and a 1972 written communication from Imbus] a substantial prevalence up to over 10% is indicated at zero exposure, an unlikely occurrence. If adjusted for this anomaly, the findings of Molyneux and Berry, [125] as plotted by Anderson et al, [157] show an increase in byssinosis prevalence well below 10% at 0.2 mg/cu m, if the presence of fine dust in amounts approaching those of medium dust is assumed. Assuming the concentration of <15 μ dust to be twice that of <7 μm dust, the data of Imbus and Suh, [17, and a 1972 written communication from Imbus] similarly treated, indicate prevalence increases of <3% at 0.2 mg/cu m. Braun et al, [92] although finding a poor correlation between dust concentration and response, reported an average of 20% of subjects with a 10% or more drop in FEV 1 at a concentration of fine (fly-free) dust of about 1 mg/cu m, compared to a 45% byssinosis prevalence reported by Merchant et al. [18] Mekky et al [49] found 20.5% byssinosis prevalence in cardrooms where the concentration of fine plus medium dust averaged 1.64 mg/cu m. Valic and Zuskin [122] reported 21% byssinosis among nonsmoking female cotton workers with about 9 years' exposure, where an average of 0.55 mg/cu m of respirable dust (presumably at least 1.1 mg/cu m of <15 μm dust) was found.

In a summation of earlier data, Roach [153] concluded that the prevalence of all grades of byssinosis at concentrations below 1 mg/cu m of total dust (0.2 to 0.3 mg/cu m of <15 μm dust) would be 4% or less.

Studies with steamed cotton [94,114] have indicated a decrease in the biologic activity of the dust produced in subsequent processing operations. Other investigators have reported a lower prevalence of byssinosis in certain occupations (eg, ring spinning, [65,125] or yarn areas, [17] and slashing and weaving [18]) at given dust levels, with the implication that higher limits might be applicable in such situations. Data [139,140] at this time do not justify a separate standard for steamed cotton.

While the correlation between incidence of byssinosis and levels of airborne cotton dust is not consistent between investigators, the data show a gradual decrease in disease prevalence with decreasing dust levels. But even at levels of 0.1 or 0.2 mg/cu m there has been a definite incidence of byssinosis. (In fact, a linear extrapolation of the data suggests a finite incidence of disease in the complete absence of cotton dust, ie at 0 mg/cu m, an unlikely result.) At levels below 0.1 mg/cu m (and perhaps even near 0.1 mg/cu m) background dust levels, indistinguishable from cotton dust by available sampling methods, would further confuse any attempt to establish a limit in this range.

For these reasons, NIOSH cannot recommend an environmental limit of cotton dust that will prevent all adverse effects on workers' health. However it is evident that lower cotton dust levels result in a decrease in the prevalence of byssinosis. It is recommended that any permanent standard also incorporate a program of medical monitoring and management, work practices, and administrative controls, as well as the lowest feasible environmental limit which has been indicated to be less than 0.2 mg lint-free cotton dust/cu m of air. [127]

In support of this recommendation, it should be noted that there is considerable evidence, both epidemiologic and experimental, suggesting that cotton dust per se is not the cause of byssinosis, but that some biologically active material, perhaps a proteolytic enzyme or a foreign protein, is carried by cotton dust into the lungs of workers and causes the disease. Research on this point as well as on other aspects of cotton dust disease should be vigorously pursued with the eventual goal of developing scientific data that will enable development of a better occupational health standard for cotton dust. Pending acquisition of more information, it is recommended that available knowledge be used to limit adverse effects in workers to the maximal feasible extent.

VI. WORK PRACTICES

(a) Operating Procedures

To reduce workers' exposure to cotton dust, management must actively seek and implement engineering controls and should maintain all engineering, dust capture, ventilation, and physical control systems in efficient working order at all times.

For those processes and areas in which engineering controls are not practicable or completely effective in reducing dust levels to the required standards, administrative controls and medical surveillance programs should be used to assure that the exposure of workers identified as reactors to cotton dust is below the recommended environmental limit (see Section I).

The operator in turn must realize that specific work practices and actions can reduce individual exposure to cotton dust. In order to insure that the employee understands that much of the effectiveness of operating procedures will be a direct result of individual actions, the following programs should be initiated in all areas were exposure may occur:

(1) Employees must be informed by supervisory and/or medical personnel of the potential health hazards of an environment where exposure to cotton dust may occur. This should include information as to the clinical symptoms of byssinosis with emphasis on such symptoms as chest tightness, their frequency and progression.

(2) Each employee shall be instructed in approved work practices to insure his understanding of the importance of specific operating procedures designed to reduce exposure to harmful levels of cotton dust and to prevent the resuspension of settled dust. Such work practices shall be posted in the workplace.

(3) Specific work practices should be established and posted for all work positions. The following example of such a work practice for an Opening Room Operator has been recommended by the American Textile Manufacturers Institute [158]:

Position: Opening Operator

Location: Opening Room

Classification of Area: High Risk Area

General Duties: The operator feeds cotton to the opening hoppers in small layers from the bales and places into hoppers. The operator also stacks baling material and performs cleaning operations around the hoppers, feed table, condenser, and general work area.

Specific Work Habits:

(A) All operators should be instructed to keep cotton as far away from his face as possible when feeding hoppers. This can be accomplished by only feeding hoppers with layers of cotton which should not exceed approximately three inches.

(B) When stacking and sorting baling material, the operator should not shake or throw material into piles. Baling material should be stacked as it is removed from the bale and should not be left to pile up.

(C) Specific locations should be designated for baling material pending removal.

(D) When performing preshift and shift cleaning operations, approved respirators must be worn regardless of the risk classification of the area.

(E) During preshift cleaning operations, all waste from under the hoppers, feed table, and condenser should be removed with the equipment provided. Waste should not be gathered up in the operator's arms to be piled.

(F) Shift cleaning shall be performed with only that equipment designed for cleaning operations.

(G) When removing chokes from hoppers and the table shafts, respirators shall be worn.

Similar work practices should be developed by management for all positions in the waste house, opening, picking, carding, drawing, combing, roving, spinning, winding, twisting, weaving, knitting, and for other locations where cotton is processed. A positive attitude on the part of plant management toward dust control is essential to an effective work practices program. Employees must be frequently reminded and encouraged to follow practices which minimize dust exposure.

(b) Personal Protective Equipment and Respiratory Protection

The most desirable means of controlling cotton dust exposure is through appropriate process design and engineering control techniques. However, individual respiratory protection devices become necessary in certain nonroutine operations not amenable to dust reduction by engineering control methods. For example, some maintenance operations must be performed inside air washers or on machinery when dust control systems are temporarily disconnected; many preshift and shift cleaning operations generate high dust concentrations and require individual respiratory protection. Respirators should only be considered for use during such operations which are performed for short periods--no longer than 1/2 hour/day. Respirators should not be used as a primary control measures in lieu of appropriate environmental controls during routine, on-going operations.

A number of different types of respirators are available for use in protecting against harmful dusts. These range from half-mask, single-use type respirators approved for use at lower dust levels to the full facepiece, air-powered regulators for protection against very high concentrations of most toxic materials. An exploratory investigation of the performance of half-mask, single-use dust respirators in a textile plant environment has demonstrated that these respirators, when properly used, can be effective in reducing cotton dust inhalation. [159] Approved single-use respirators had filtering efficiencies ranging from 93-99% and were reported to be generally convenient from the standpoint of being lightweight, offering low resistance to breathing, and requiring little or no maintenance. Higher degrees of protection are provided by half-mask and full-facepiece type regulators with replaceable filter elements.

In addition to a proper respirator, an effective respirator program should include appropriate operating procedures and employee training in respirator use. All operations and locations where respirators are required should be clearly specified and so designated in the workplace. Adequate instructions should be given to employees on respirator fit, adjustment, inspection, and any necessary maintenance or replacement. Frequent random inspections should be conducted by the plant safety engineer, nurse, industrial hygienist or physician. A maintenance program should be established to ensure that respirator filters and disposable respirators are changed according to practices outlined in American National Standard Practices for Respiratory Protection, Z88.2. [160] Employees experiencing any breathing difficulty while using respirators should be referred to a physician for evaluation.

Where respirators are furnished for use by workers, they shall be those approved by the National Institute for Occupational Safety and Health and/or the Bureau of Mines for pneumoconiosis-producing dusts. Whenever respirators are used, a respirator program conforming to the requirements of the Occupational Safety and Health Standards, part 1910.134 shall be followed. (29 CFR Part 1910.134 published in the Federal Register, volume 39, page 23671, dated June 24, 1974)