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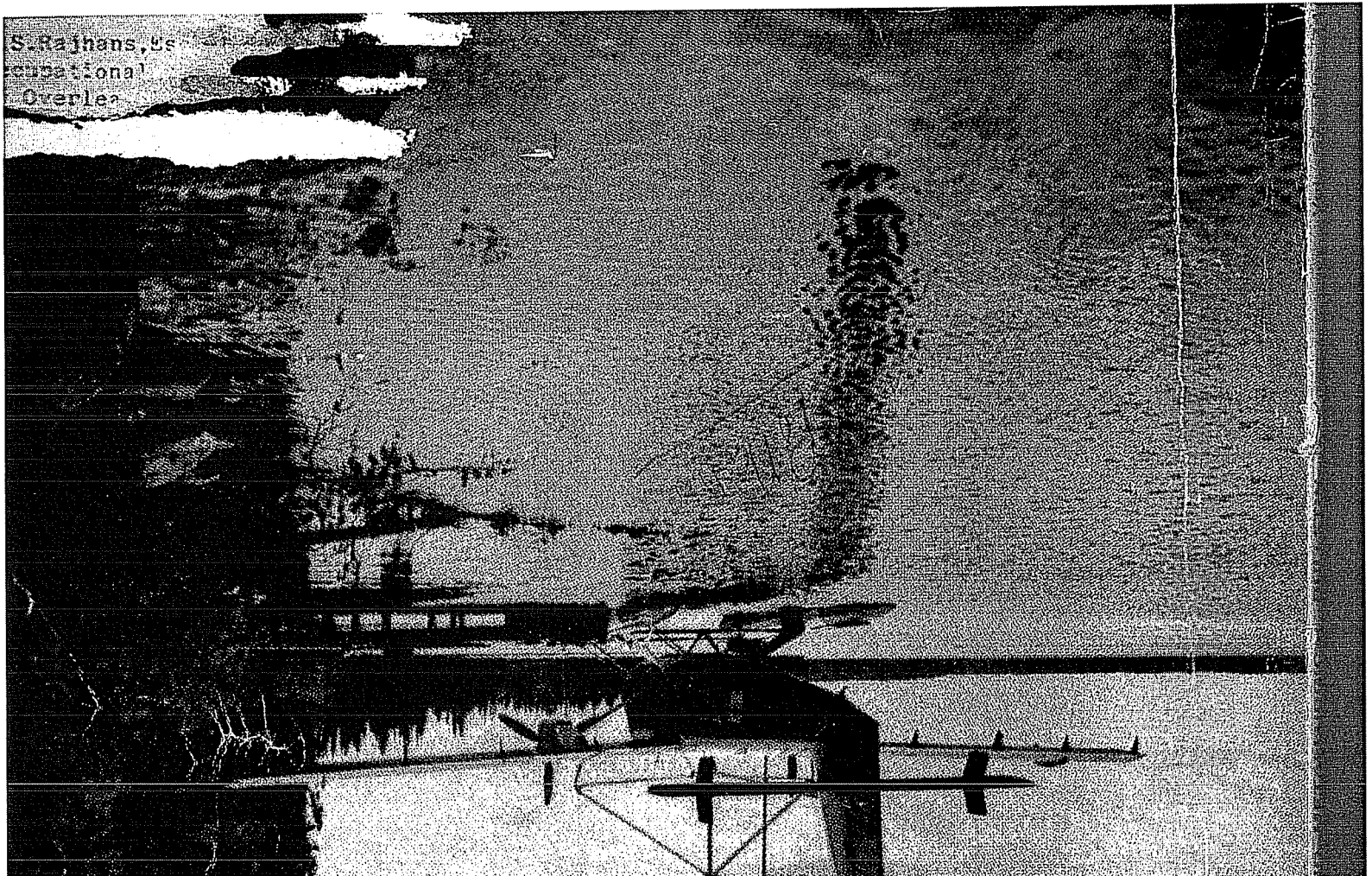
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SYNOPSIS

Talc Dust and Its Toxicity

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Introduction

THE WIDESPREAD USE of 'talc' and 'talcum powder' in industry and by the public has elicited much interest in its toxicity in recent years. Talc dust has been reported to cause pneumoconiosis, lung cancer, cancer of the pleura and gastrointestinal cancer. Although there is no general consensus regarding the various health effects of talc dust, it is universally agreed that the continued inhalation of significant amounts can produce a special kind of pneumoconiosis generally referred to as talcosis.

According to the medical experts, talcosis appears as a fine diffuse pulmonary fibrosis similar to asbestosis in appearance. Much of the difficulty in establishing a causal relationship between talc dust and various pulmonary changes is due to the fact that commercial talc usually contains a variety of silicates such as asbestos, tremolite and anthophyllite, and other ingredients such as quartz or free silica, which by themselves could produce severe pulmonary reaction. Thus, there is a need to clarify the mineralogy from the occupational health standpoint. A search through the literature on talc pneumoconiosis reveals to the writer that the published studies of this disease are mostly case histories and have seldom made attempts to separate the effects of the different mineral impurities in talc. The purpose of this report is to offer up-to-date knowledge on varieties of commercial talc currently used industry and the health hazards associated with it and its associated minerals.

Toxicity

The steatite variety of talc, when ground to a powder, appears as microscopic dumb-bell-shaped flakes, less than 75 micrometers in size. This powder is called talc dust. Talc particles smaller than 7 micrometers, when inhaled, are carried directly into the lungs, where their effect may produce a pulmonary disease called talcosis.

However, as stated earlier, there is no such thing as pure steatite or asbestine or soapstone, because any commercial talc may contain a variety of accessory minerals. As a result, there is a great deal of controversy and confusion as to which components of the talc are responsible for pneumoconiosis.

Tremolite and anthophyllite impurities in dust are in the form of long fine needles with a thickness of about 0.8 micrometer and a length of 5-15 micrometers. Therefore, these fibres are mostly respirable and are considered to be capable of producing all those diseases which are usually associated with asbestos fibres; e.g. asbestosis, carcinoma of the lung and mesothelioma.

Thorel[1] in 1896 described the first case of talc pneumoconiosis. Since then, several studies have been published [illegible] disease has now become a definite

mines handling steatite talc with a 10% tremolite content. They found severe and disabling cases among the groups working at average dust concentrations of 135 to 300 mppcf (million particles per cubic foot). A large number of studies have been done among the talc mine workers of New York State. Siegel *et al.*[3] in 1943, published a chest X-ray survey of 221 talc miners. The survey disclosed pulmonary fibrosis in 32 workers, 18 of whom had had no other occupational dust exposure. This study was later followed up by Kleinfeld *et al.*[4] in 1954, and they found that the pneumoconiosis was progressive and disabling. In 1959, Messite *et al.*[5] pointed out that workers exposed to both fibrous and non-fibrous varieties of talc suffered from pulmonary fibrosis. A report on the clinical and pathological findings in six patients, who had an average exposure to talc dust of 26 years with a range of 20 to 33 years, was reported by the same authors[6] in 1963. The major clinical features were chronic productive cough, dyspnea, diminished breath sounds, limited chest expansion, diffuse rales and clubbing. In 1967, Kleinfeld *et al.*[7] published mortality data on 91 talc miners and millers in New York State who had 15 or more years of exposure to talc dust by 1940 or had achieved 15 years between 1940 and 1965. Proportional mortality from carcinoma of the lung and pleura among talc workers was four times that of the control population. The dust exposure consisted predominantly of talc mixed with other silicates such as serpentine and tremolite, carbonates and a small amount of free silica. The average dust counts between 1940 and 1965 varied from 5 to 1227 mppcf.

Schepers and Durkan[8] studied the intravenous and intratracheal effects of the different New York commercial talc components (3 micrometers or less) in animals. Besides using individual minerals, they also carried out experiments with different mixtures of minerals. Their results indicate that talc is predominantly cytogenetic, whereas tremolite and anthophyllite fibres markedly affected the degree of fibrosis — the longer fibre being much more damaging in this respect. Animal experiments were also carried out by Luechtrath and Schmidt[9] and Schulz and Williams.[10] They concluded that the fibrogenic activity of talc dusts was mainly due to impurities. The greatest amount of fibrous tissue was produced either by the samples containing talc-serpentine mixtures or tremolite with small quantities of serpentine and carbonate. This theory has been challenged by Kleinfeld *et al.* in a recent article[11] which reports on a clinical and environmental study made of a group of 39 workers exposed to tremolite- and anthophyllite-bearing talc. The data show that, in spite of a mean exposure of 16.2 years, only one of the workers exposed showed a chest roentgenogram consistent with pneumoconiosis.

To date, only two studies have been made and reported on workers exposed to talc dust in the rubber industry. The first study was conducted by Hogue and Mallite[12], who were unable to find any abnormalities in workers exposed to talc dust used as a dusting

Miller *et al.*[12] studied the lungs of a rubber worker who had had heavy exposure to talc dust from 1941 to 1950 and who died with cor pulmonale in 1962. The patient had progressive dyspnea and cachexia. However, the authors could not demonstrate the exact mineralogy of talc particles found in the lungs.

Recently, a few articles have been published on the health hazards associated with cosmetic talcum powder. In 1968, Cralley *et al.*[14] reported that talcum powder contained a significant amount of respirable fibres and was a potential source of the ferruginous bodies observed in the lungs of humans. It is, however, agreed by the authors that exposure in the use of cosmetic talcum products is very intermittent and much smaller than continuous industrial exposure. The only reported cutaneous reactions from the use of talcum powder involve talc granulomas, and these also have been rare.[15,16]

Merliss[17] suggested that the high incidence of gastric cancer in Japan may be associated with the treatment of rice with talc. He noted that some commercial talc contains asbestos, which he proposed as an etilogic agent in gastric cancer. This theory has recently been doubted by Smith[18], who carried out tests for carcinogenicity of various preparations of asbestos and talc, including the fibrous variety in 45 hamsters, and found no gastric or other tumours.

The basic conclusion that one can derive from the studies reported above is that, of all the varieties, the fibrous form of talc dust (tremolite and asbestine) is probably the most hazardous. The granular variety (steatite), on the other hand, could produce symptomatic pneumoconiosis providing there is exposure to *significant levels. The signs and symptoms are those* common to other pneumoconioses; e.g. diminished breath sounds, basilar crepitations, limited chest expansion, dyspnea and cough. Chronic bronchitis and emphysema are frequently associated with this disease.

Assessment of Health Hazards and TLV

As there are basically two groups of talc, granular (non-fibrous) and fibrous, it seems advisable to have two different sampling techniques and threshold limit values. Because commercial talc may contain a variety of accessory minerals which may or may not be detrimental to health, it is also advisable to analyse every sample of talc before a particular technique or threshold limit value (TLV) can be applied. The American Conference of Governmental Hygienists proposes a TLV of 20 mppcf for the granular variety and 5 fibres/ml greater than 5 micrometers in length (same as asbestos) for talc containing fibers. The TLV of 20 mppcf is based largely on the work of Dressen and Dallavalle[2] and is determined from impinger samples. The technique of impinger counts has been described in detail by the writer elsewhere.[19] The TLV of 5 fibres/ml for talc containing fibres is determined because of the striking similarity in the fibrotic reaction produced by talc and asbestos fibres.[8,14] The membrane filter technique used for fibre counts is described by Edwards and Lynch.[20] The Occupational Health Laboratory of the Ministry of Health has introduced several modifications to the technique. These modifications have been described in reference 19.

Both the impinger and membrane filter techniques involve relatively short-time samplers unless the membrane filter is attached to a personal sampler. Hence, one must be very careful in comparing the dust on concentrations over an 8-hour period. It should be realized that the concentration of dust in the air to which a worker is exposed varies depending on the nature of the operation, the type of work performed by the operator and the position of the operator relative to the source of dust. Furthermore, the amount of dust inhaled by a worker can vary daily and seasonally. In order to obtain representative samples of workers' exposures, it is necessary to collect samples under varying working conditions and then a comparison should be made with the TLVs.

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