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RISK OF ASBESTOSIS IN WORKERS WHO WORK AT REPLACING BRAKE LININGS

M.A. Boillat and M. Lob

Amianthus of asbestos is a fibrous silicate found in two main forms: amphibole silicates (ex: crocidolite) and serpentine silicates (ex: chrysotile). Its resistance to acids and fire, its insulating power, its ability of being woven or being mixed with other products make amianthus a substance with several uses: insulation, fire-protection walls, fibrocement, friction material (brake linings). Asbestosis is a severe pneumoconiosis whose characteristic is a progressive interstitial pulmonary fibrosis. The incidence of some cancers such as pleural and peritonal mesotheliomas, and bronchial carcinomas increase with inhalation of asbestos fibers. Generally, 10 to 20 years of exposure are necessary for asbestosis to appear.

The illness is characterized, on the clinical level, by non specific respiratory symptoms (dyspnea, cough, expectorations, pleural pains). In examinations, the following are found: a limitation of thoracic expansion and diaphragmatic excursion and a reduction of the vesicular murmus with occasionally crepitant rattle at the bases. The progress of the affliction can end in descriptions of pulmonary heart.

The study of the respiratory function allows, at times, to detect troubles before lesions appear on the x-rays. Precociously attained parameters are vital capacity (CV) and compliance.

The x-ray image is that of a fibrosis especially marked at the lower 2/3 of the pulmonary fields with adhesions and possible pleural calcifications. Heart's outlines can be hazy.

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Object of the Study

Although there are several publications relative to the manufacture of brake linings, to our knowledge, there are no works dealing with the risk of asbestosis in people working on machining these linings. That is the object of this study.

The composition of a brake linings (in %) is shown on Table I, reproduced from Lynch (9).

In the companies we visited, the asbestos concentration in brake linings varies, according to the information obtained, from 20 to 70%. Let us point out that Lynch et al quote figures of 30 to 60%. The type of amianthus generally used is chrysotile. Machining of the linings occurs when the old parts are replaced by new ones. First of all, the old linings are removed from the their metal brake shoes which are then sanded. The new linings present themselves either in the form of rolls which must be cut or are already cut. They are fastened to the shoes by riveting or glueing, then adjusted by grinding.

Although, in most cases, the machines are provided with a suction system, dust escapes into the atmosphere when the brake shoes are cleaned and especially during sanding, drilling and adjustment of the linings.

TABLE I

Constituents	Vehicles	Trucks
Amianthus	55%	33%
Resins and polymeres	28%	48%
Oxydes and pigments	9%	16%
Metals	3%	2%
Carbon, graphite, etc.	5%	1%
	100%	100%

Sampling, Test Methods

Nine suspected companies were studied including 39 workers involved in machining of brake linings. Table 2 gives some characteristics of this sampling.

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	$\bar{x}$	S
Age (years)	39	15
Height (cm)	171	7
Weight (kg)	72	13
Number of cigarettes/day(27 smokers)	20	11
Exposure to amianthus (years)	8	8

We wish to stress that it is impossible to estimate the exact exposure because machining is an operation which occurs in a very irregular and intermittent fashion, an average of ½ to 2 hours per day.

Three companies, representatives of the whole group, were chosen to evaluate the concentration of total dust or to be able to count the number of amianthus fibers according to the standard technique recommended by American health officials.

Each worker underwent a physical examination: anamnesis, status, pulmonary function (vital capacity = CV,maximum expiratory volume/sec. = VEMS, "peak-flow", maximum ventilation/minute = VMM, maximum flow measured at semi-expiration = DMMÆ), electrocardiogram, chest x-ray, hemoglobin, sedimentation rate. The pulmonary function was studied by means of a Fleisch Spirotest and Sandoz M403 analyzer.

Results

Let us recall that CNA gives for MAC values (maximum admissible concentration of a given substance over an 8-hour day exposure) of total dusts the figures of 1-2 mg per m3 depending upon the amianthus content of these dusts. These figures are exceeded at just about all work places examined. For US health officials, the number of asbestos fibers of a length equal to or greater than 5 microns must not exceed 5 per cm3. owever, they allow a value between 5 and 10 fibers/cm3 for 1/4 hour of exposure and this for a maximum of 5 times per day. If we consider the fact that this is the level of exposure observed in the companies examined, there results from Table 3 that the value of 5 to 10 fibers/cm3 is only exceeded at one of the sites examined. Furthermore, we wish to stress the difficulty of counting fibers under the microscope which can lead, for a same filter, to relatively different values (example, sanding work station with values of 2.1 and 5.7 fibers/cm3).

TABLE 3

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Company	Job	Total Dusts (mg/cm3)	Asbestos (fibers/cm3) Of 5 µm
1	Finishing	3±1	3.5
	Drilling	10±1	0.6
	Sanding	17±2	2.1(5.7)
2	Sanding	9±1	6.2
	Adjustment and sanding	32±5	13.8(29.2)
3	Sanding	2±1	0.3(0.4)

Figures in parentheses represent a second count.

Clinical Examination

In the antecedents, of the 39 people questioned, 18 had an unblemished respiratory anemnesis, 13 suffered from ORL affections (sinusitis, frequent colds, nose fractures, otitis). Also noted were one asthma, one asthmatiform, 5 pneumonias and 3 tuberculoses contracted in the past.

At the time of examination, 19 people did not show any respiratory symptoms, 6 showed a slight exertion dyspnea, 15 generally an occasional cough and 13 mentioned some expectorations.

The clinical examination allowed to show up 3 cases of arterial hypertension and one case of asthmatiform bronchitis.

Spirometry

Figure 1 shows the CV values measured in function of the theoretical values by the pulmonary function laboratory of Mayo Clinic. These theoretical values are low. Any lower value is to be considered as pathological.

We noticed that only one person had a pathological CV.

On figure 2, the same measured CV values were reported but in function of the values recommended by Kory et al (8).

Here too, although the distribution is different, only one person showed a pathological value. The same result was obtained starting from Buehlmann and Scherrer tables. Here all the measured values are placed somewhat lower than in the preceding figures.

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The VEMS values obtained by the use of the M403 analyzer are, on the average, 15% higher than those given by the Fleisch Spirotest(fig. 3). Let us specify that the two devices had been previously calibrated one to the other.

Figures 4 and 5 show the VEMS values obtained, on the one hand, with the M403 apparatus, and, on the other hand, with the Fleisch Spirotest, this function of the hteoretical values according to CECA tables. The M403 apparatus gives 2 values which are located below the minimum value, whereas, with the Fleisch Spirotest, the number of 8, only one of which is obviously pathological.

The peak-flow values (M403) confirm the observations made for the VEMS. As for the VMM values (M403) they all are above the theoretical values given by Fruhmann and Ziegler.

The DMME values, determined with the aid of the Fleisch Spirotest, are reported in figure 6. They all are within normal limits if referred to tables of Birath et al. In summary the spirometric results (M 403) showed up one case of obstructive syndrome and one case of obstructive and restrictive syndrome if referred to the values registered with the Fleisch Spirotest.

Radiology

Pulmunary x-rays were examined by two radiologists. They were interpreted as follows (Table 4):

TABLE 4

Normal slate	28 people
Pleural calcification	1 person
Pleural afeter-effect	1 person
Tubercolosis (old or suspicion of an active one)	5 people
Suspicion of descending syndrome	2 people
Emphysema	1 person
Chronical bronchitis	1 person
Doubtful cases	2 people

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Laboratory

The average hemoglobine value is 17 ± 1 g%.

Casuistry

The results of the tests we have just described allowed to exclude asbestosis in 37 workers. Only in two cases, an interpretation problem arises.

Case No. 1
G.D., 73 years old, 84 kg, 170 cm. Exposure for 5 years. Hazy capacity of the two bases, left paracardiac shadow, probably of pleural origin. Decrease of the diaphragmatic excursion, sibilances and grumbles at auscultation CV-20% (Mayo Clinic) VEMS and peak flow-50%. Left axial deviation and AV block at ECG. Despite the radiological and functional alterations, the diagnosis of asbestosis is very improbable, in view of the short exposure time and especially since this worker, obese and old, had been treated for 4 years for an asthmatiform bronchitis which is enough to explain the present picture.

Case No. 2
G.Z., 39 years old, 63 kg, 166 cm, exposure over 17 years. The x-rays show a discrete increase of bronchiovascular pattern at the two bases. Auscultation s.p. No subjective trouble. Good diaphragmatic excursion. Normal spirometry and ECG results. Here the x-ray pictures and the long exposure time could make one suspect an asbestosis. However, the probability of this diagnosis is slight in view of the excellent spirometry results.

Conclusions

In view of the actuality and seriousness of asbestosis, it was indispensable to define if there existed a risk in a body of trades which had never, it seems, been, until now, the object of detailed investigations, that is, the workers involved in the machining of brake linings, whose asbestos content varies from 20 to 70%. True, this risk seemed, at first, quite low in view of the fact that the exposure time of the workers rarely exceeds 2 hours per day and, more often than not, is less than that.

The results of our tests did not allow us to detect one certain case of asbestosis among the 39 subjects studied. In one case, the radiological and functional alterations are explained by a past of an asthmatiform bronchitis in al old and obese man whose exposure to asbestos dusts was hardly five years. In this subject, the x-ray image could make one suspect a case of asbestosis in its early stage, especially since the exposure had been prolonged (17 years). The absence of all subjective or functional trouble, obviously calls for reservations as to the reality of this diagnosis.

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As for air analyses, they undoubtedly revealed the presence of asbestos fibers. In this regard, it seems that it was impossible to compare the dust particles issued when machining the linings to those resulting from their normal wear; in fact, in this case, it was demonstrated that the dust particles contained only a low amount of fibers, this probably due to a material transformation brought about by the high temperatures caused at the time of braking. However, in the companies we studied, if we keep in mind the relatively short exposure time during the work day, it is probable that the limit values recommended by US health officials are not exceeded if it is not perhaps at one work site. Therefore, asbestos risk seems slight. This opinion is corroborated by the fact that 3 workers exposed for a long time (21, 21 and 35 years) do not present any sign of asbestosis although they were working during a period when work conditions were not as favorable as today's.

herefore, this study allows giving reassuring results: however, it must be pointed out that the collected data studied include only about 40 subjects and that these are studies which have been limited only to a single period of time. Given the seriousness of asbestosis and especially its cancer potentials, we cannot prejudice the future. This is why periodic tests of this group of trades are indispensable, as well as the strict controls of the conditions of the workplace.

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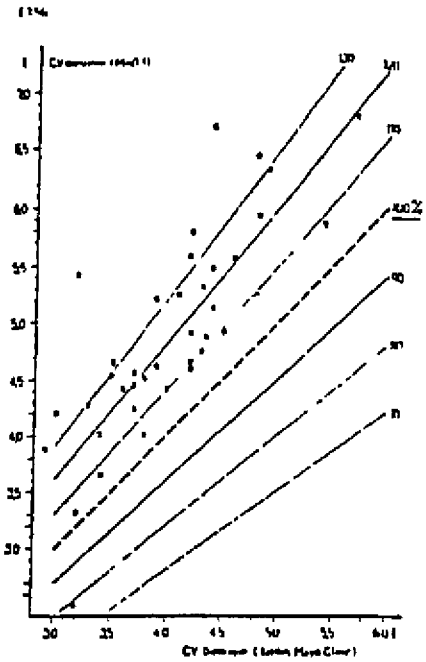


Fig. 1 Valeurs CV mesurées avec l'appareil M 403 chez 39 ouvriers procédant à l'usinage de garnitures de freins. (CV théorique selon les tableaux Mayo Clinic).

CV values measured with M403 device on 39 workers employed in the replacement of brake linings (theoretical CV as per Mayo Clinic tables)

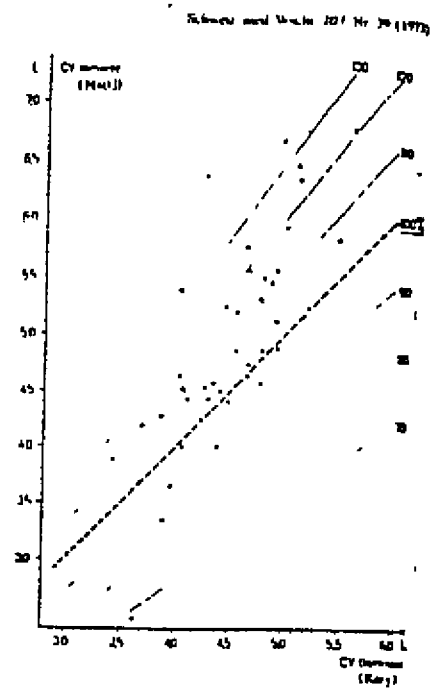


Fig. 2 Valeurs CV mesurées avec l'appareil M 403 chez 39 ouvriers procédant à l'usinage de garnitures de freins. (CV théorique selon Kory et coll.)

CV values measured with N403 apparatus on 39 workers replacing brake linings (theoretical CV as per Kory et al).

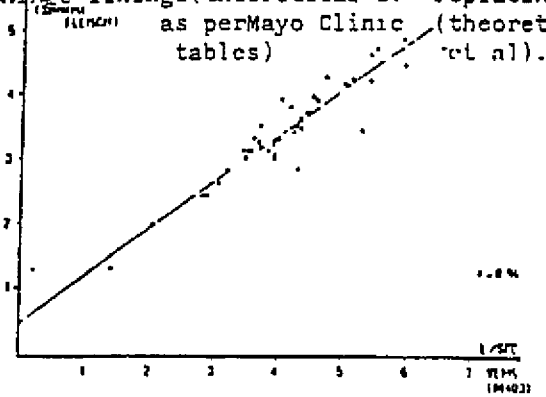


Fig. 3 Valeurs VT M15 mesurées chez 39 ouvriers procédant à l'usinage de garnitures de freins.

CV value measured on 39 workers employed in the machining of brake linings.

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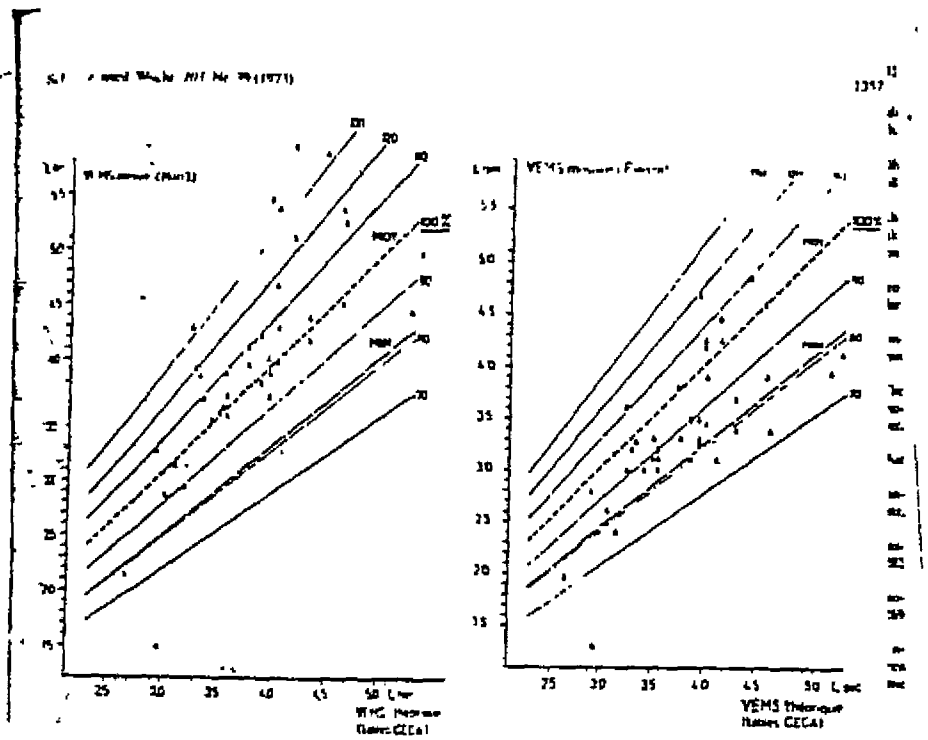


Fig. Valeurs VEMS mesurées avec l'appareil M 403 chez 39 ouvriers travaillant à l'usinage de garnitures de freins.

Fig. 3. Valeurs VEMS mesurées avec le Spirotest de Fleisch chez 39 ouvriers travaillant à l'usinage de garnitures de freins.

VEMS values measured with M403 on workers replacing brake linings

VEMS values measured with Fleisch Spirotest on 39 workers replacing brake linings

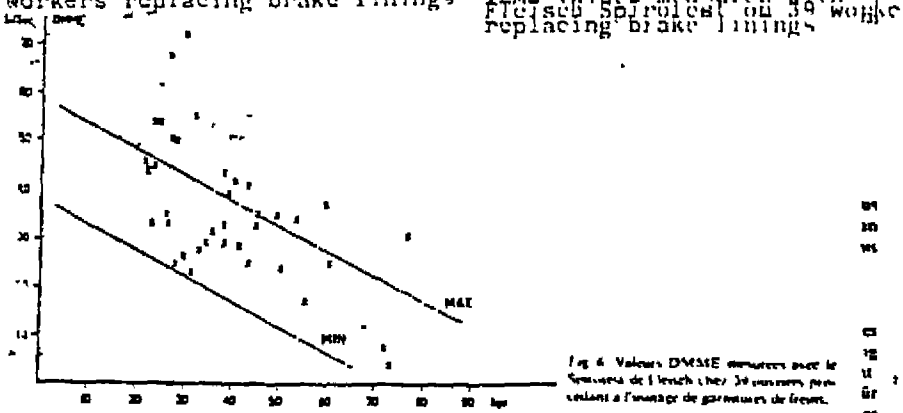


Fig. 4. Valeurs DMME mesurées avec le Spirotest de Fleisch chez 39 ouvriers travaillant à l'usinage de garnitures de freins.

DMMK values measured with Fleisch Spirotests on 39 workers replacing brake linings

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