



Mesothelioma in a Wine Cellar Man: Detailed Description of Working Procedures and Past Asbestos Exposure Estimation

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ABSTRACT

A pleural mesothelioma arose in an employee of a wine farm whose work history shows an unusual occupational exposure to asbestos. The information, gathered directly from the case and from a work colleague, clarifies some aspects of the use of asbestos in the process of winemaking which has not been previously reported in such details. The man had worked as a winemaker from 1960 to 1988 in a farm, which in those years produced around 2500 hectoliters of wine per year, mostly white. The wine was filtered to remove impurities; the filter was created by dispersing in the wine asbestos fibers followed by diatomite while the wine was circulating several times and clogging a prefilter made of a dense stainless steel net. Chrysotile asbestos was the sole asbestos mineralogical variety used in these filters and exposure could occur during the phase of mixing dry fibers in the wine and during the filter replacement. A daily and annual time weighted average level of exposure and cumulative dose have been estimated in the absence of airborne asbestos fiber monitoring performed in that workplace. Since 1993, the Italian National Mesothelioma Register, an epidemiological surveillance system, has recorded eight cases with at least one work period spent as winemaker. Four of them never used asbestos filters and presented exposures during other work periods, the other four used asbestos filters but had also other exposures in other industrial divisions. For the information hitherto available, this is the first mesothelioma case with exclusive exposure in the job of winemaking.

KEYWORDS: asbestos exposure assessment; chrysotile; cumulative dose; exposure estimate; epidemiological surveillance; mesothelioma; past exposure; unusual asbestos exposure; wine filters

INTRODUCTION

This report describes the occurrence of mesothelioma following exposure to asbestos during a period of work as a cellar master in a wine farm. The case was identified through the epidemiological surveillance of mesothelioma, which has been active in Tuscany (Italy) since 1988. Exposure was important and had taken place

before the Italian asbestos ban in 1992. The interview, administered directly to the case ([Stewart et al., 1994, 1998](#)), has highlighted the use of asbestos in the filters for wine clarification and a consequent unusual occupational exposure. During his whole working life he did not suffer any other asbestos exposure, being employed as office clerk in two other periods. The

association, albeit rare, has been occasionally reported in the past (Scansetti *et al.*, 1984). Other reports have described the presence of fibers in wines treated with asbestos filters (Bignon *et al.*, 1977; Dufour *et al.*, 1978; Gaudichet *et al.*, 1978a, b), but none described how filters were used and the circumstances in which wine cellar workers inhaled the fibers. The information collected directly from the patient and from a work colleague, provides previously unreported aspects of asbestos use in the process of winemaking.

Clinical history

The subject, a non-smoker man born in 1933, had enjoyed good health until October 2012, when a sudden and progressive dyspnea forced him to attend the emergency room of the hospital. A right pleural effusion was detected and a subsequent thoracoscopy showed the presence of pleural mesothelioma, which was confirmed in December by histology including immunohistochemistry (Sarcomatoid type).

Work history and technical description

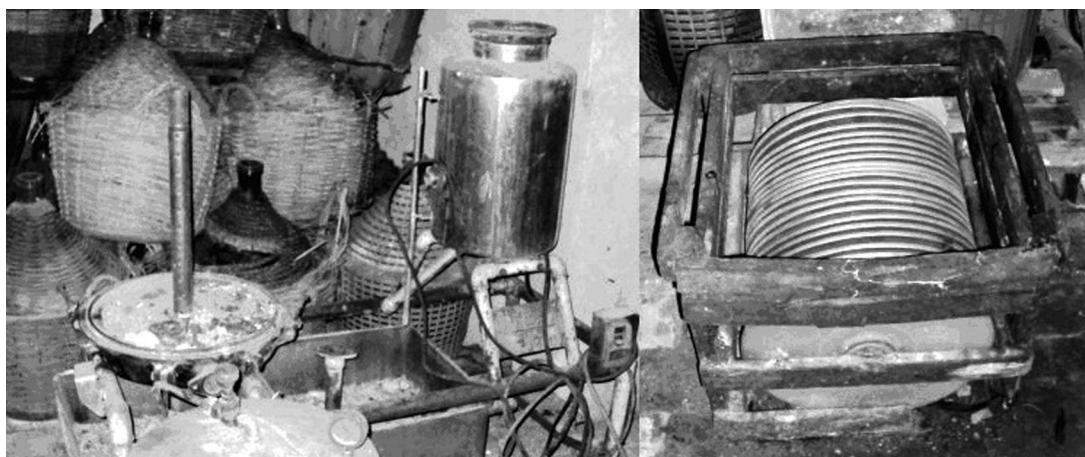
The man had worked as a winemaker from 1960 to 1988 in a farm producing around 2500 hectoliters of wine per year, mostly white.

The wine, before marketing, is filtered to remove impurities which may allow the proliferation of bacteria, and those that cause an unsightly turbidity. At the time in that farm, wine filtration was performed using a 'duplex filter machine' manufactured by an Italian firm based in Reggio Emilia (Figs 1, 2). This machine consisted in two tanks: a closed one for storing the diatomite and another with a bell shape for the filter. The latter was constituted by several centrally perforated concave steel disks with the top formed by a dense metal wire mesh. Each disk was connected with the central tube by several holes and each disk was separated by the other by rubber seals. The entire set of stacked disks was covered with the bell shaped tank, sealed at the bottom.

The wine filtration included several work steps. Initially, about 50L of wine were poured into a



1 Filtering machine.



2 Dismantled filter and filtering disks.

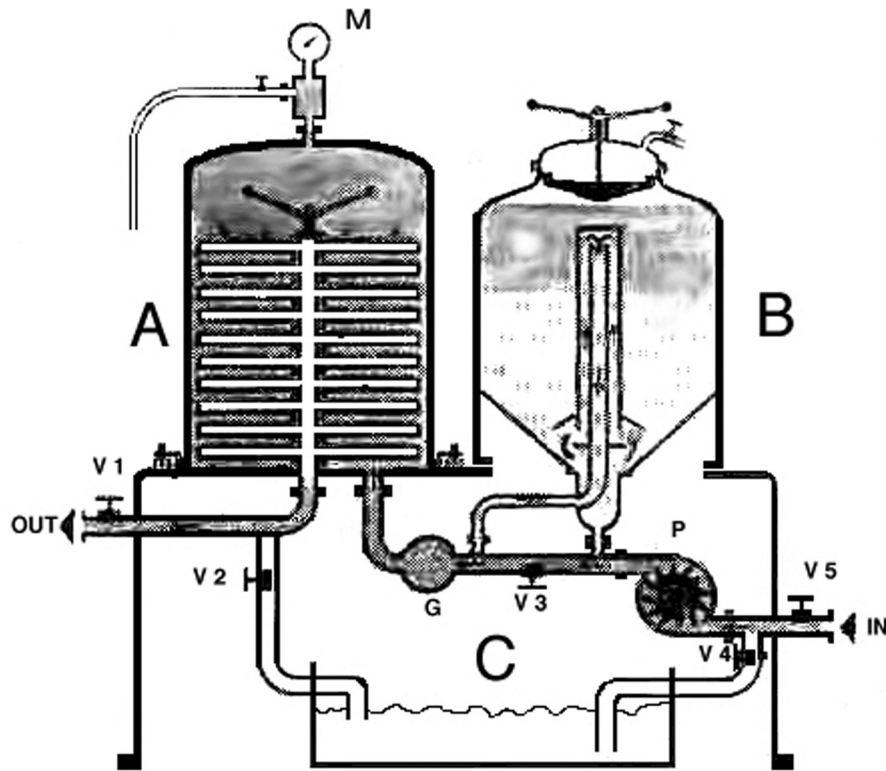
stainless steel open tub 'C', placed at the base of the filtering system and a certain amount of diatomite was placed in the closed tank 'B' (Fig. 3). The filter was not prefabricated; it was created in the bell tank 'A' in two phases. The first one was carried out by dispersing a certain amount of asbestos fiber on the surface of the wine placed in the open tub 'C'. The suspension so produced was pushed, by the pump 'P', into the filtering tank and back again into the open tub. The fibers started to clog the metal net and once the wine was cleared from the fibers, the flow, by a system of valves, was diverted to the closed tank 'B' where the wine mixed with diatomite. After several rounds of passage through the new circuit diatomite tank—filter tank—open tub, the winemaker himself judged the completion of the proper filter from the degree of opacity of the wine, visible in the open tank. In practice, the filter was considered formed when the wine became completely clear ('bright' in the jargon used in the workplace). At this stage, the proper filtration could start: the cloudy wine was pumped through the filter and was stored in the clean vat, ready to be sold. According to the opacity of the wine which needed the use of slightly different filtration techniques, the filtration layer could be continuously renewed by the use of the diatomite tank without interrupting the filtration process. Normally about 1300 L of wine could be cleared with the same filter. When the pressure in the circuit increased because of gradual clogging, the machine was emptied and the filter was dismantled by lifting the bell tank to remove the metal disks, one after the other. The cellar man removed the clogged

filter, which appeared like a wet dough, and put it in a bucket. Subsequently he rinsed the disks with running water and reassembled them in the bell tank to start a new filtration cycle. The resulting waste was then thrown in the adjacent fields without any precaution.

Filtering asbestos fibers

We have been able to reconstruct the chain of asbestos purchase through original purchase orders and invoices available in the farm archive and in the historical article archive of the main Italian manufacturing company of asbestos-containing materials located in Grugliasco, near Turin, in production until 1984. The documents show that the farm bought the fibers from a dealer in Florence from 1959 until 1975. The dealer bought the material from a manufacturer and the invoices were recovered from 1959 to 1975. The manufacturer was named S.I.A. (Società Italiana per l'Amianto) which had commercial relation in Italy but also in foreign countries. The historical article archive of S.I.A. (De Palma, 2001) is now deposited in Grugliasco municipality and available for consultation. Requests may be sent to: resp.arc@comune.grugliasco.to.it. The availability of this archive has a major importance for those who need to track purchases of asbestos with quali-quantitative data.

The raw asbestos produced in the mine plants was reprocessed by manufacturers with the use of mullers, in order to open the bundles of fibers. The original technical brochure of asbestos for filters has been found in the same historical archive. The description says: 'Fibers for enological filtration are provided by



3 Filtering machine cross-sectional diagram. A = filter tank, B = diatomite suspension tank, C = open tub, G = glass porthole, M = manometer, P = pump, V = valves.

processing of white asbestos (chrysotile) having the minimum content of iron and carbonates. Asbestos fibers for filtration are perfectly sterile, and rot, therefore, does not give the filtered wine either smells or tastes'

Annually, the farm consumed about 180 kg asbestos, bought in bags of one kilogram, while the annual consumption of diatomite was about 1000 kg. The use of asbestos in the filters continued until about 1975.

Condition of exposure

Wine filtration was usually performed in the early months of the year, following completion of fermentation and sedimentation of the coarse fraction of the wine (the so-called 'dregs'), to the bottom of the barrels. In a working day, the cellar man performed two cycles of filtration, for a total of about 25 hectoliters of wine. Filtration lasted about four months. Every day, the cellar man used about 2 kg of asbestos in two separated operations for the formation of two filters. This work consisted in opening the article bag containing the fiber and in shedding the mineral on the surface of the wine. To avoid the formation of lumps, fibers were carefully scattered on the surface of the wine with an

oscillatory movement of the ladle. The empty article bags remained on the floor and were removed during the evening cleaning. Exposure to asbestos could also occur at the time of replacement of the filter; in fact, the change of the filter in itself did not constitute a source of risk, given that the removal occurred when the dough was still wet. Nevertheless, the residues accidentally fallen on the floor of the cellar, if dried, could release fibers into the air by means of re-entrainment caused by trampling, sweeping etc. A mitigation of dust production was probably due to the fact that most of the time the cellar floor was wet. In any case, the level of the so-called background pollution inside the cellar could have been slightly higher than one outdoor. During the process, the cellar man never used respiratory protective equipment and the conditions of exposure remained the same for the whole working period.

METHODS

Past exposure estimate

Since environmental sampling or personal risk assessment has never been undertaken, exposure values in

that particular place are not available. Therefore, our estimates were based on techniques of past exposure reconstruction in absence of monitored data proposed and used by various authors in conjunction with published data collected in similar jobs or tasks, although not properly intended for this particular activity (Hornung *et al.*, 1996; Orłowski *et al.*, 1997; Verdel *et al.*, 1997; Williams *et al.*, 2007). The exposure profile can be defined as intermittent with important peak levels at the opening of the bags and during the spreading of the fibers. It was a daily work lasting an average of 4 months year⁻¹. A previous Italian study reported data for a company manufacturing products for the wine industry, including asbestos for filters (Scansetti *et al.*, 1979, 1984), where chrysotile asbestos from the Balangero mine was pulped through mullers. In that study, the manual opening of the raw asbestos bags, the weighing and the filling of article bags were monitored. Maximum concentrations above 22 f cc⁻¹ at bag opening, 12–15 f cc⁻¹ near the scale and 1 f cc⁻¹ in the surrounding environment were reported. However, the only analogy with the cellar work is the material in itself: chrysotile asbestos. The (unnamed) manufacturing company described in the article of Scansetti *et al.* (1979) used chrysotile asbestos from Balangero Mine. Information was also taken from the few circumstances in which the opening and emptying raw asbestos from bags or boxes, in other industrial settings, were monitored. In unpublished report from asbestos cement manufacture, airborne asbestos fibers monitoring during the opening of the bags, in presence of exhaust ventilation, reported 2.65 f cc⁻¹, whereas the withdrawal of carded asbestos from boxes without any dust control was reported to generate 7.19 f cc⁻¹ (Bresson, 1979). The duration of the operation at risk is the other key parameter for the reconstruction of exposure: in this case report, it was stated by the case himself.

RESULTS

Estimating the instant level of pollution created by the action of opening a bag and the subsequent spreading the fibers on the wine surface therefore has great uncertainty. A reasonable range based on published data can be set between 7.2 and 22 f cc⁻¹. The background pollution inside the room is supposed to be higher than outdoor: an acceptable (albeit arbitrary) assumption is that it could have been three orders of magnitude lower

than the peak level estimated during the manipulation of the fibers (0.02 f cc⁻¹). The duration of the operation at risk was around 5 minutes and it was performed twice a day. Given the estimated figures of airborne fibers produced during this work, the estimated value of background pollution and the duration of exposure, the result of the daily Time Weighted Average exposure of the cellar man is 0.32 f cc⁻¹ (range 0.17–0.48 ff cc⁻¹). Given the seasonality of this work with a duration of about 100 days year⁻¹ and given the close to non-existent exposure for the rest of the year, the annual Time Weighted Average exposure would have been about 0.13 ff cc⁻¹ (range 0.07–0.2 f cc⁻¹). Cumulative exposure for the 15 years of work of this cellar man turns out to be about 2.0 f cc-year (range, 0.5–3.0 f cc-year)

Risk estimate

An undisputable information, regarding the case described in this report, is that the mineral variety of the asbestos used in wine filters was chrysotile. As reported in the Hodgson and Darnton work published in 2000 (Hodgson *et al.*, 2000), a cumulative exposure to chrysotile asbestos around 1 f ml-year carries a risk of 5 deaths per 100 000 exposed with an uncertainty interval ranging from 1 to 20. In our case with a cumulative exposure around 2 f ml-year the estimated risk should be slightly higher. Within the Tuscany Mesothelioma Registry 1988–2013 list of 2035 cases, this is the first mesothelioma occurring in a winemaker for which exposure could be ascertained and estimated in terms of intensity. Between 1993 and 2008, the Italian National Mesothelioma Register has recorded eight cases with at least one period as a cellar man of their working life (Italian National Mesothelioma Registry, 2008). From the work histories of these eight cases it appears that four of them were exposed to asbestos in other periods and not during the work of winemaker. The others were exposed during the work of winemaker, but also during other periods of their lives. For the latter, we cannot even exclude an exposure to amphibole asbestos. The case presented in this article appears, therefore, to be the first with exclusive exposure to chrysotile in the winemaking division. The time interval between the first exposure and the onset of the disease is 52 years, this latency is compatible with the occupational origin of the disease and in line with the average latency duration nowadays observed in mesotheliomas.

Wine contamination

No data are available on the potential presence of asbestos in the wine filtered in that particular cellar. However, comparison with data shown in the literature regarding liquids filtered in the same manner is possible. In analyses performed by Transmission Electron Microscopy 15 out of 42 wine samples were found to be positive for the presence of asbestos in a range of $2\text{--}64 \times 10^6$ fibers per litre (Bignon *et al.*, 1977; Gaudichet *et al.*, 1978a, b; Dufour *et al.*, 1978). Establishing whether this has resulted in a risk to those who drank asbestos contaminated wines is impossible. The World Health Organization (WHO), in 2003 states: *'Asbestos is a known human carcinogen by the inhalation route. Although well studied, there has been little convincing evidence of the carcinogenicity of ingested asbestos in epidemiological studies of populations with drinking-water supplies containing high concentrations of asbestos. Moreover, in extensive studies in animal species, asbestos has not consistently increased the incidence of tumours of the gastrointestinal tract. There is, therefore, no consistent evidence that ingested asbestos is hazardous to health, and thus it is concluded that there is no need to establish a health-based guideline value for asbestos in drinking-water (WHO, 2003).*

Unlike contaminated water, wine does not seem to release fiber after drying (on the floors or clothes) (Cunningham *et al.*, 1971).

DISCUSSION

The use of chrysotile asbestos fibers in filters for beverages, in particular for wine, has been ascertained by declaration of this mesothelioma case and proven by purchase invoices.

The intensity of exposure to airborne asbestos fibers has never been monitored in the workplace we are describing and our estimates derive from the few data available in the literature. The upper estimated value might be underestimated because fibers for filtration were always strongly reprocessed in order to obtain well 'opened' fibers. It is presumable that these fibers were more easily dispersed than raw material arriving directly from the mine. As far as the estimate of the background pollution, the 1 f cc^{-1} reported by Scansetti *et al.* (1979) during the pulping of the fibers is hardly applicable to our case, given that the quantities of asbestos involved in the process being monitored were around $100 \text{ tons year}^{-1}$, roughly three

orders of magnitude higher than the amount of asbestos employed in the cellar we are describing.

None of the other eight cases of mesothelioma registered in the Italian National Archive, with past activity in wine cellars, reported exposure to asbestos exclusively in wine filtration. On the other hand, this particular case list might be underestimated because other cases could have been registered as simple 'agricultural workers' without specification about their tasks.

The relevance of the case previously described by Scansetti (Scansetti *et al.*, 1984) is uncertain because of three reasons: (i) his activity was not winemaker, he worked in the manufacture producing asbestos for wine filters (Scansetti *et al.*, 1979) in other words, he had to deal also with raw asbestos and not just opened fibers. (ii) This case presented a very short latency period of 7.5 years which has been rarely reported (Bitchatchi *et al.*, 2010) when in most of the cases this period is much longer (Marinaccio *et al.*, 2007; Ahn *et al.*, 2009).

(iii) His work history includes a previous period spent in sugar refineries, where amosite asbestos insulations of machinery and pipes were highly diffused. The national mesothelioma registry reported 109 cases certainly exposed in sugar refineries (0.99% of cases from 1993 to 2008). There is no specific information about his actual job but the probability he was exposed to asbestos is very high and compatible with latency and pathology.

In terms of risk estimation the lack of official figures on the number of cellar men employed in Italy between '50's and '80's and the additional uncertainty on the subgroup of asbestos users does not allow a reliable calculation. A rough estimate of the number of workers during the period of interest would pose a number between 5000 and 10000 employees across the country. This would mean that the risk at 2 f cc^{-1} year cumulative exposure could be almost comparable with the one established by Hodgson *et al.* (2000) at 1 f cc^{-1} year for chrysotile.

This study has incidentally highlighted another condition of exposure to crystalline silica dust. It is well known that diatomite contains more than 60% of crystalline silica. Therefore, while the risk of asbestos exposure can now be excluded, at least in the countries where the use of asbestos is banned, the crystalline silica exposure might persist where diatomite is still used for wine filtration. However, it has to be noted that many modern filtering machines, in these days,

involve the use of filters made of pressed cellulose cardboard.

CONCLUSION

The mesothelioma occurrence in a winemaker, described in this article, is the sole in the national case list with a single exposure to asbestos during wine filtration. He was exclusively exposed to chrysotile asbestos fibers used as constituent of filters. This use of asbestos fibers was very diffused in wine production countries. In Italy it continued until 1988 when the sale of loose fibers was prohibited by a decree. The history of this case underscores the importance of collecting information of the entire work history directly from the subjects suffering from asbestos related diseases and mesothelioma, in particular during the epidemiological surveillance. The absence of this information precluded a full discussion of cases possibly linked to this type of work. The reconstruction of past exposure, in terms of quality and quantity, proves to be a useful tool for estimating the risk in relation to the variety of mineralogical type of fiber used and in terms of dose.

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