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HEALTH, SAFETY & ENVIRONMENT
JOHNS-MANVILLE CORPORATION

HAIRDRYER ASBESTOS EMISSIONS

APR 10, 1979

Jos G. I just found this. I suggest you order all documents in the Manville Archives in a word search for "Hairdryers" (1 + 2 words)

Conard Metcalf Randall with Maggie Baumgartner there in Denver and can give you directions for that, he's a plaintiffs lawyer (303-442-0173). Barry

P.S. Please return the

Emissions of Asbestos Fiber From Hair Dryers Containing Asbestos Paper Insulation

As a result of a petition filed by the Environmental Defense Fund with the Consumer Product Safety Commission, on March 29, 1979 the Johns-Manville Industrial Hygiene Laboratory commenced a series of tests to measure the levels of fiber emission from hand-held hair dryers containing asbestos paper insulation. The new hair dryers used in this series of tests were purchased on the open market, while the "old" models were borrowed from employees. One model which did not contain asbestos paper was used to investigate the background level of asbestos fiber for the sampling and analytic procedures used in the laboratory. Ideally, such laboratory tests are conducted under "clean room" conditions so that the background fiber counts would be negligible. The volume of air emitted from the dryers and other considerations, however, made this impossible. Under any conditions it is good science to investigate background levels.

The tests were run under three different conditions. In one case, the air was sampled by passing through pre-filtered water in a large plastic container. After the designated running time, equal aliquots of this water were filtered through both Millipore and Nuclepore filters. These filters were then submitted to the microscopic laboratory for examination by both transmission and scanning electron microscopy.

The second method of the sampling was direct sampling of the air from the dryer using a high volume sampler. The

dryer was attached to a tube and all the air emitted from the dryer passed through the tube. In this case a known fraction of the air emitted from the dryer was drawn through a Millipore filter for a specified period of time. The air volumes were measured with a thermal anamometer and corrected for temperature. The sampling was also done under near isokinetic conditions so that fibers in all size ranges would be captured. In this case it was not possible to sample on Nuclepore filters, therefore, the only analysis which was carried out was by transmission electron microscopy.

The third method was to sample the air, with a high volume sampler, in the immediate vicinity of a simulated normal use test.

For analysis by scanning electron microscopy, a 1 centimeter diameter section of a Nuclepore filter was cut out and mounted on an aluminum sample stub. This sample was then coated with carbon in a vacuum evaporator and then examined directly in the scanning electron microscope at 1500X magnification. Some of the pictures included in the report were taken at either higher or lower magnifications. Lower magnifications were used in order to show a larger and more representative area of the filter surface, whereas higher magnifications were used to show more details of the asbestos fibers encountered. All of the fibers encountered were chrysotile asbestos. This

was confirmed by energy dispersive x-ray analysis. In several of the pictures there are very low contrast artifacts that appear on the surface of the filter. These are the desicated remains of bacteria which grew in the water between the time the sample was taken and the time that the aliquot was filtered. These images are not to be confused with asbestos fibers.

For transmission electron microstopy, the Millipore filters were first treated as recommended by the Millipore Corporation to collapse their structure, and then coated with carbon in a vacuum evaporator to "glue down" particles remaining on the surface. A three millimeter diameter portion of the filter was then placed on a carbon coated electron microscope grid and the filter material cleared using the cold finger acetone extraction method. Proper pretreatment of the filter media prior to the extraction allows complete clearing to take place within 30 minutes so that the possible loss of particulates is held to a minimum. After clearing, the electron microscope grid is ready for examination. For this analysis 15 complete grid squares were examined at a magnification of 48000x. The presence of chrysotile fibers was verified by both electron diffraction and by energy dispersive x-ray analysis. In order to quantify the amount of chrysotile fiber present, the dimension of each fiber bundle, fibril or clump was recorded so that the mass could be calculated. The mass was calculated assuming a cylindrical

cross section for fiber bundles and a specific gravity of 2.60 grams per cubic centimeter. The mass of the clumps was not included in the calculation because, in most cases, they were mixtures of chrysotile fibers and other unidentified materials. It was not possible in most cases to count and measure the dimensions of all fibers in a clump. The vast majority of these clumps contained only short chrysotile fibrils which would contribute very little to the total mass of fiber emitted.

It is imperative to understand the various ways numbers are used to describe airborne asbestos. Current OSHA standards for occupational exposures to asbestos are:

> "Standard Effective July 1, 1976. The 8-hour time-weighted average airborne concentrations of asbestos fibers to which any employee may be exposed shall not exceed 2 fibers, longer than 5 micrometers, per cubic centimeter of air, as determined by the method prescribed in paragraph (e) of this section.
>
> Ceiling concentration. No employee shall be exposed at any time to airborne concentrations of asbestos fibers in excess of 10 fibers, longer than 5 micrometers, per cubic centimeter of air, as determined by the method prescribed in paragraph (e) of this section."

The extremely heavy occupational exposures of the past which are responsible for the morbidity and mortality experience of occupational cohorts have been orders of magnitude (i.e. 10X, 100X, 1000X) higher than permitted by present OSHA standards.

However, to put fiber levels measured in the hair dryer tests into perspective with occupational exposures, even the highest airborne levels predicted in laboratory experiments by EMV and J-M would not be statistically detectable using the sampling and analytical techniques for occupational exposures pursuant to the OSHA asbestos standard.

For example, in the membrane filter method for analyzing occupational exposures to asbestos, it is acceptable to count a few fibers on unused, new blank filters taken directly from the box. A count of up to 5 fibers on a blank is considered acceptable according to the NIOSH document P&CAM 239, which describes the analytical method (Asbestos Fibers In Air). If a personal sample is taken for two hours in the workplace (assuming a 2 liter/minute sampling rate) and a counting area of .005 mm^2 (a size in the recommended range) is used on the microscope, each fiber counted "represents" 0.007 f/cc if 100 fields of view are counted. Even if the maximum 2-hour bundle count estimate in the EDF petition is assumed to be entirely airborne in 18 M^3 of space, that would give:

$$\frac{9.5 \times 10^4}{18 \times 10^6} = 0.53 \times 10^{-2} = 0.005 \text{ f/cc}$$

which is less than what a single fiber "represents" in the above example and in which is predictably found on blank, never used filters. The extremely small numbers used here are for purposes of illustration only, as it is widely known that the occupational sampling/analytical procedure is not capable of reliably measuring at these extremely low levels.

The purpose of the discussion of occupational exposures is not to suggest that non-occupational exposures should be permitted to approach OSHA's permissible occupational exposure levels, but rather to address and refute the EDF data which imply that fiber levels emitted from hair dryers may approach OSHA's permissible occupational levels. Such an inference is scientifically specious.

More sensitive sampling/analytical techniques utilizing electron microscopy must be used for the very low levels encountered from hair dryers, in contrast to the method for measuring occupational exposures to asbestos. Even these more sensitive techniques have limitations and studies to improve the accuracy and precision of electron microscope techniques are on-going. For example, two quotes from EPA Technology Series, EPA-600/2-78-038 (June 1978) are appropriate for this discussion:

> "The presence of a few large bundles of fibers strongly influence mass concentration estimates."
>
> and
>
> "The conventional transmission electron microscope is superior to the scanning electron microscope for detecting and identifying chrysotile fibrils."

To paraphrase the above, few fiber bundles generally strongly bias the mass concentration (i.e. too high) and TEM is superior for the evaluation of the smaller fibrils.

Since EMV Associates reported such extremely small mass quantities, and particularly since they disturbed the asbestos liners before conducting a test for the release of asbestos fibers, serious doubts must be raised as to the validity of their data and the conclusions reached therefrom. Specifically, the EDF petition describes the EMV tests as follows:

> "All size dryers had asbestos liners. This was confirmed by examining a small section of the liner by the SEM/EDXA method described before. When this confirmation took place before the test for asbestos release, the cut edges of the liner were sealed with glue."

The calculations in the EDF petition are puzzling. The assumed average bundle size of 2X2X30 microns is quite large. Assuming a 2X2X30 micron size, if a 2X2X30 box shape is assumed, that gives a volume of $120X10^{-12}$ cm^3. A specific gravity of 2.6 gives a mass of $312X10^{-12}$gm or 312 ng, which does not agree with the 0.52 ng * * given in the footnote to Table 1. *

A more realistic assumption of a cylinder shape would yield a volume of 94.25 cm^3 and a mass calculation of 0.245 ng, instead of .52 ng.

Since the EMV study:

1. Found few bundles, which bias the mass on the high side,
2. Used questionable scientific procedures, and
3. Presented mass calculations which are incorrect,

the EMV results are of questionable validity and emphasize the need for additional testing.

The water sampling (duplicating the EMV test) done by J-M involved four dryers (three with asbestos paper) and four tests (one of the dryers with asbestos paper was run twice.) Twenty grids were counted for each test, with only a single bundle (quite large and non-respirable) observed in total in all the tests. This is in contrast to the numbers of bundles given in Table 1 of the EDF petition. None of these numbers should be viewed as definitive. Rather, the lower SEM counts in the J-M data and questionable scientific procedure in the EMV tests point to the need for additional studies.

In addition to the water analyses conducted by J-M by SEM, TEM work on the water samples and TEM work on the air samples were done by J-M, which provides us with additional data not obtained by EMV. The mass determinations by TEM are significantly lower than SEM mass estimates in the EDF Table 1. ($P < .03$ using 2 tailed Wilcoxon 2 sample ranks test).

When one considers the conclusions in EPA's Technical Series, EPA-600/2-78-038 (June 1978) regarding the significance of a low count of bundles and the fact that moisture is normally present in a bathroom which suppresses dust, that exhaust fans or windows are always present to remove fibers and that routine vacuuming and cleaning will also remove fiber, the lower order of magnitude of the mass (as determined in J-M's TEM analyses) which was

found to be emitted from the dryers lead us to conclude that the figures in Table 3 of the EDF petition (which Table was contructed from the highest reported finding) are at least two orders of magnitude too high. Therefore, the concentrations of asbestos speculated in Table 3 of the EDF petition should be reduced to the range of the EPA survey of urban and rural air as set forth in Table 4 in the EDF petition. At the same time, it should be noted that we question the accuracy of the numbers reported in Table 4 and their validity and application in assessing potential risk.

The quantitative analysis of asbestos fibers by electron microscopy is not an exact science. The precision is extremely poor when compared to chemical analyses in general. In addition, because of the very poor precision very little is known regarding the accuracy of analyses by electron microscopy. Finally, there is very little agreement among workers in this field regarding the methods that should be used to collect and prepare the samples for this kind of analysis. However, most workers do agree on one major point. The transmission electron miscroscope, and not the scanning electron microscope, is the instrument of choice for this type of analysis. Only by the former method can the extremely small asbestos fibers normally found in the environment be detected and characterized reliably. The results obtained by the two methods in this series of tests demonstrate this difference quite dramatically.

One of the principal sources of error in quantitative electron microscope analysis can be traced to the extremely small fraction of the sample which is actually examined. In many cases the detection of a single fiber requires a multiplication by a factor as large as 1,000,000 to determine the final concentration. Even if there were no errors involved in the collection or preparation of the sample for examination, there is irreducible statistical variation in counting that can be a major factor. In this type of analysis it must be recognized that other errors are unavoidable, therefore we

must be content with the fact that errors as large as a factor of 10 will be commonplace. In consequence, very little credence should be placed on the absolute value of any numbers reported by these methods. They are only indicative of the approximate quantities of material present.

The petition filed by the Environmental Defense Fund asking for a recall of all hair dryers containing asbestos insulation, assumes the data provided by EMV Associates were accurate. Furthermore, the petition assesses the potential risk involved by making comparisons with data obtained by other laboratories by entirely different methods. Because of the intrinsic inaccuracies of the methodologies, one cannot make meaningful comparisons of data obtained by different methods in different laboratories. The only way in which any degree of consistency might be obtained would be in comparing results within a single laboratory by the same analyst. In any event, such data cannot, and should not, be used as has been done by EDF as a means of comparing the risk associated with exposure to these low levels of asbestos fiber. Those who do make such risk assessments are doing so with the apriori assumption that any exposure whatsoever to asbestos fiber can cause disease. However, there is no evidence to support such an assumption. All available evidence leads to the opposite conclusion.

There is an increasing body of evidence which indicates that

exposure to very low levels of asbestos fiber, as found in non-occupational and non-paraoccupational situations, are not responsible for disease in man. Several arguments in this regard are presented in the attached addendum to the testimony of Dr. J. P. Leineweber before the House of Representatives Subcommittee on Elementary, Secondary and Vocational Education. This document, together with the documentation in the form of published papers by recognized authorities in the field, is now part of the record of HR 3282 now before the House of Representatives.

There are two additional concepts which are put forth in the EDF petition which must be corrected. First, they imply that all of the fiber which is released from a hair dryer will accumulate and remain in the room in which the hair dryer is used. What they did not consider is the fact that homemakers normally clean their homes on a regular basis. Each time a room is cleaned with a vacuum cleaner one would have to assume that at least 90% of the accumulated fiber would be removed from the environment. Wet mopping of a bathroom floor would probably remove an even greater percentage of any accumulated fiber. In any event, periodic cleaning will remove a significant portion of any dust.

Secondly, from reading the EDF petition, one might get the impression that all of the fiber released from the dryer will be inhaled by the user. This is manifestly not so.

Based on existing knowledge, loosely bonded asbestos paper as an insulator in the barrel of hand held hair dryers represents an inappropriate use of asbestos. We believe that non-locked-in uses of asbestos fiber, which result in the release of fiber to the ultimate user, should be replaced with appropriate substitutes. However, it must also be recognized that there is no evidence to indicate that the use of hair dryers containing these asbestos papers poses a health hazard to anyone. The fiber concentrations emitted are, in fact, consistent with those found in urban environments for which there is absolutely no evidence of risk.

In conclusion, the manufacturers of hair dryers should be requested to discontinue the use of asbestos paper. However, the general public should also be informed that there is no evidence to indicate that the continued use of hair dryers containing asbestos paper will pose a health hazard to anyone. Therefore, such hair dryers need not be recalled.

We conclude from our review of the EMV data as well as from the results of our own studies that asbestos fibers released incidental to the usual use of hair dryers creates no health hazard. This is entirely compatible with epidemiological data derived from persons exposed to ambient concentrations of asbestos (non-occupational and non-paraoccupational).

The absolute numbers in the EDF petition and in this J-M study are meaningless from a health hazard point of view. What is meaningful is that small numbers of fibers are being observed and that most of those are either non-respirable or too short to be biologically active. The evidence suggests that the EMV results overstate the mass of asbestos emitted by hair dryers. Furthermore, even the highest airborne fiber levels that can be calculated using unrealistic assumptions (e.g. all fibers remain airborne) predict airborne fiber levels orders of magnitude below current permitted occupational levels.