

WOOD DUST EXPOSURE

FOREST INDUSTRY HEALTH RESEARCH PROGRAM

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The purpose of this FIHRP bulletin is to communicate information on recent developments in the evaluation of health effects related to wood dust exposure. The bulletin briefly summarizes information on exposure to wood dust and workers' health, and lists future publications that will provide more information. A package of documents used to prepare this bulletin is available to member companies from the Pulp and Paper Forum. To request a copy, phone **Agi Lee** at the Pulp and Paper Forum at (604) 777-1533, send a fax to (604) 777-1567 or email alee@paperforum.com. Non-members of the Forum may be charged for the reports.

KEY POINTS:

- A working group of the International Agency for Research on Cancer (IARC) has classified wood dust as a human carcinogen. The official announcement is expected in the spring of 1995 when the Monograph is published.
- The classification is based on results of epidemiology studies that showed marked increases in the occurrence of cancers of the nose and sinuses among workers exposed primarily to hardwood dust.
- The highest excess risks are seen in European studies; North American studies found either lower or no increased risk. The lowest risk estimates are for workers exposed mainly to softwood dusts.
- Workers with the highest risk of developing nasal cancer had the highest exposures to wood dust.
- Time from first exposure to wood dust to diagnosis of nasal cancer is reported to be an average of 40 years. Cases diagnosed now reflect exposures many years ago.
- The mechanism by which wood dust increases the risk of nasal cancer is not known. Naturally-occurring wood extractives may be responsible.
- Wood dust concentrations in B.C. sawmills are generally less than 1mg/m³.
- Published studies show no evidence of an excess risk of nasal cancer for pulp and paper mill workers. However, the studies would not have detected elevated risks for small groups with high wood dust exposures.
- Workers with high exposures to wood dust, for example, to more than 5mg/m³, should be identified through a monitoring program. Control measures should be implemented to decrease high exposures.
- Wood dust is currently exempt under WHMIS regulations but will be a controlled product under WHMIS II. MSDS's, labels, and training of workers will then be required.

IARC EVALUATION OF WOOD DUST

In October 1994, a working group of the International Agency for Research on Cancer (IARC) met in Lyon, France, to evaluate the carcinogenicity of wood dust. One member of the working group is Dr. Paul Demers, an Assistant Professor at the University of British Columbia, Occupational Hygiene Programme. In a paper summarizing the evidence examined by the committee [1], Dr. Demers states:

"After consideration of the available human and animal evidence, the committee classified wood dust as a human carcinogen (Group 1). The evidence was very strong for a relatively rare form of cancer, sino-nasal adenocarcinoma, and exposure to wood dust. There was clear evidence for exposure to hardwood dusts, while the evidence for softwood dust was less conclusive and there was inadequate data to evaluate particular tree species."

The IARC evaluation reads:

- There is *sufficient evidence* in humans for the carcinogenicity of wood dust.
- There is *inadequate evidence* in experimental animals for the carcinogenicity of wood dust.
- Wood dust is *carcinogenic to humans (Group 1)*.

A footnote to the IARC evaluation states: "This evaluation is based on the observation of a marked increase in the occurrence of cancers of the nasal cavities and paranasal sinuses among workers exposed predominantly to hardwood dusts."

The International Agency for Research on Cancer was established by the World Health Organization (WHO) to conduct research studies on associations between cancer and human exposures to individual chemicals, physical substances, microorganisms, mixtures of chemicals, and other agents.

IARC establishes international working groups of experts to evaluate the carcinogenic risk of exposure to agents or mixtures, and to publish monographs reviewing the evidence that certain exposures could alter the incidence of cancer in humans.

Publication of the Monograph on wood dust is expected in the spring of 1995. This will be the official announcement of the working group's decision. The Monograph will describe results of studies on nasal cancer and present evidence supporting the IARC classification.

The Canadian Pulp and Paper Association has prepared a document that presents an overview of issues related to wood dust exposure [2]. Distribution to member companies is planned for February 1995. CPPA is also preparing a risk communication package.

BACKGROUND

In the 1960's, studies in Britain identified a strong association between nasal cancer and employment in the furniture industry. The increased risk for a rare form of nasal cancer, adenocarcinoma, was up to 500-times greater than for the general population. The trades principally affected were wood machinists, cabinetmakers, and chair workers who were exposed to fine, dry, wood dust from working with hardwoods such as beech and oak.

In the 1970's and 80's, epidemiological studies were conducted in other European countries and increased risks of nasal cancer were reported for furniture workers from Belgium, France, and Denmark. Studies also confirmed elevated risks of sino-nasal cancer for broader categories of workers classified as exposed to wood dust. The lowest relative risk estimates were for workers exposed mainly to softwood dusts.

In the 1980's, an American study did not find increased risks in the furniture industry, but did find positive associations with other wood-exposed occupations, including lumbering and carpentry.

In 1987, IARC published a Monograph (Supplement 7) which included an evaluation for wood dust exposed industries [4]. The conclusions were:

- Pulp and Paper Manufacturing. No reports of an increased risk of nasal cancer for pulp and paper workers.
- Lumber and Sawmill Industries (including Logging). Nasal tumours are linked with work in these industries.
- Wood Industries: Carpentry and Joinery. Nasal cancer risk is suspected, but it may be associated with the chemicals used to impregnate wood, or with the many other chemicals that carpenters use.
- Furniture and Cabinet-making. Employment in the industry is associated with nasal adenocarcinoma. An increased risk for other types of nasal cancers is indicated in some studies.

In 1994, the IARC working group classified wood dust as a human carcinogen. The group found that studies published since the 1960's have been relatively consistent in finding an excess risk of sino-nasal cancer among workers exposed to wood dust. The highest excess risks are observed in European studies. Studies in North America have found either lower or no excess risk [1].

The working group found that published studies show no evidence of an excess risk for pulp and paper mill workers exposed to wood dust. However, few studies of the pulp and paper industry have reported nasal cancer and the risk among pulp and paper workers with the highest exposure to wood dust has not been evaluated [1].

IARC has requested data from all countries on studies of cancer incidence for pulp and paper workers. The findings from individual studies are expected to be published starting in 1995 and the overall analysis published in two to four years.

STUDIES RELEVANT TO WORKERS IN BRITISH COLUMBIA

- 1981 BC Cancer Control Agency conducted a study of 121 men who developed sino-nasal cancer between 1939 and 1977 [4,5]. Occupations involving exposure to wood gave an increased relative risk of 2.5 (corrected for smoking history and ethnic origin). Smoking produced a higher relative risk of 4.9. Of the 28 wood workers with nasal cancer, 10 were loggers, 7 were carpenters, 4 were labourers in the forest industry, 4 were construction workers, 2 were log scalers, and 1 was a cabinetmaker.

The author states that "The much lower risk seen in these occupational groups compared with English furniture makers may reflect the type of wood used (soft rather than hard), the state the wood is in (coarse and unseasoned rather than kiln-dried), the process used (rough sawing and construction rather than fine finishing), or the place of work (outdoors or in large indoor areas rather than in small shops), or a combination of these factors. Even a relative risk of 2.5 implies that in a patient with a long history of exposure to wood the disease is likely to be due to that "occupation" [5].

- 1991 Researchers in Seattle examined relationships between development of nasal cancers and employment in wood-related occupations in western Washington State. The seven woodworkers with nasal cancer had been employed as machine operators, loggers and a carpenter; none had worked in the furniture industry.

The authors found that employment in a wood-related occupation gave an increased relative risk for nasal cancer of 2.4. The data were then analyzed further to focus on long-term employment (10 years or more). The authors concluded that "After control for major risk factors, employment in wood-related occupations was most strongly associated with nasal cancer, especially when analysis was restricted to long-term employment 15 or more years before diagnosis (odds ratio = 7.3)" [6].

1994 Dr. Kay Teschke, Associate Professor, Health Care and Epidemiology, UBC, interviewed 48 people with nasal cancer who were registered with the BC Cancer Agency, and 159 controls from the BC Voters' list [3]. Questions were asked about jobs, carcinogen exposures, diets, medical histories and smoking status.

Sawmill workers and forestry and logging workers had a lower risk of nasal cancer than expected. Pulp and paper mill maintenance workers (three cases) showed an increased risk of nasal cancer. Dr. Teschke suggests that the cause is not likely to be exposure to wood dust; "The exposure of interest is likely to be nickel and hexavalent chromium from stainless steel". These compounds are recognized human carcinogens for development of nasal cancer [3].

Dr. Teschke says that "Although many individuals are exposed to wood dust in British Columbia, the results of this study are consistent with recent evidence that exposures are relatively low in the major provincial wood industries (mainly forestry, sawmills, and wood-frame house construction)".

1995 BC Cancer Agency is conducting a cohort study of BC pulp and paper mill workers examining deaths and diagnosed cases of cancer. Results are expected to be published in the fall of 1995 and will provide current data on relative risks of nasal cancer.

Johns Hopkins University is conducting a cancer mortality study of U.S. pulp and paper workers employed in the industry for more than 10 years. The first set of results is scheduled for publication in the summer of 1995.

CHARACTERISTICS OF WOOD DUSTS

Wood dust is produced whenever wood or wood products are cut or worked. The size of wood dust particles and the amount of dust produced will depend on many factors, including: type of wood; wet or dry wood; and type of process such as sawing or sanding.

Hardwood trees (angiosperms, i.e., plants with covered seeds) generally have broad leaves, and are deciduous in temperate climates. Softwood trees (conifers or gymnosperms, i.e., plants with naked seeds) are cone bearing, and generally have scale-like or needle-like leaves. The terms hardwood and softwood have no direct relation to the hardness or softness of the wood. Hardwood trees such as cottonwood and aspen have softer wood than the western white pines and true firs. Some softwoods, such as longleaf pine and Douglas fir, produce wood that is much harder than that of yellow poplar [7].

Wood contains a variety of complex organic extractives, such as, tannins, terpenes, quinones, and resin and fatty acids, which contribute to wood properties of colour, odour, and decay resistance. Extractives in wood are usually present at less than 5% by weight [8]. The amount of extractives found for a particular species varies within the tree, from tree to tree at one location, and for trees growing at different locations.

The large variability in wood properties is one factor in the uncertainty of identifying a cause for the increased incidence of sino-nasal cancer. The mechanism that allows wood dust to produce nasal

tumours is not known. Wood extractives are considered possible candidates, but the nature of suspect substances needs considerable investigation.

DURATION OF EXPOSURE AND LATENCY PERIOD

The minimum length of time that wood workers were exposed to dust before diagnosis of nasal cancer is reported to be 5 years [9].

Nasal cancer may develop many years after exposure started, this is called the latency period. Studies report an average period of 40 years after first exposure to wood dust or employment in the industry until diagnosis of nasal cancer [9].

Sino-nasal cancers found now are the result of exposure many years ago. Wood dust levels in pulp and paper mills and wood manufacturing mills 40 years ago were probably considerably higher for most workers than exposure levels today. While airborne concentrations at mills have decreased over the years, some workers may still be exposed to wood dust concentrations close to or higher than accepted limits. Hence the need to do some exposure monitoring.

MEASUREMENTS OF EXPOSURE

The exposure of individuals will depend on operations at each mill and the nature of the work. Some factors that affect exposure levels are type of wood, moisture content of wood, working environment, and job location relative to sources of wood dust.

The IARC working group found that studies were consistent in reporting the highest risk of developing nasal cancer for workers with the highest exposures [1].

Wood dust concentrations reported for Danish furniture industry workers ranged from 0 to 80mg/m³ for personal samples collected in the worker's breathing zone. The average dust exposure was 14mg/m³ at the machine and hand-sanding operations, and 5mg/m³ for drilling, planing and sawing. Mean exposures in sawmills and general construction have been lower, ranging from 0.5 to 2.1mg/m³ [9,10]. Dr. Teschke published a paper on measurement of wood dust concentrations at two British Columbia sawmills [10]. Wood dust concentrations were generally low. "All but three of 224 total wood dust concentrations were below the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV®) of 5mg/m³ for soft wood dusts". The mean total dust concentration was 0.51mg/m³, with a range from less than 0.08 to 52mg/m³.

EXPOSURE MONITORING

If exposure data are not already available, a wood dust monitoring program should be developed and total dust samples collected to measure workers' exposure. The Joint Health and Safety Committee at each mill could be involved in planning the program and communicating results.

Initially, monitoring could focus on workers likely to have the highest exposures, particularly exposures greater than the permissible concentration (5mg/m³). Controls to decrease high exposures should then be implemented. Variability of exposures and estimates of average exposure also need to be addressed as part of a monitoring program. The next FIDHRP bulletin will discuss sampling methods and present suggestions for monitoring programs.

EXPOSURE LIMITS FOR WOOD DUST

In 1979, the American Conference of Governmental Industrial Hygienists (ACGIH) recommended a lower Threshold Limit Value (TLV) of 1mg/m³ for hardwood dusts, such as beech and oak, found in

furniture-making (adopted 1981). No change was recommended in the TLV of 5mg/m³ for nonallergenic softwood dusts.

The table below lists current BC Workers Compensation Board permissible concentrations, Threshold Limit Values (TLV's) recommended by the American Conference of Governmental Industrial Hygienists for 1994/95, and US Occupational Safety and Health Administration (OSHA) standards. Exposure limits in other countries range from 1 to 20mg/m³ [2,9].

As part of the WCB regulation review, exposure limits for wood dust will be reviewed. Recommendations for wood dust and other substances are scheduled for submission to the Board of Governors in the fall of 1995.

AGENCY	DESCRIPTION	8-hr TWA	15-min STEL
		mg/m ³	mg/m ³
WCB / PC	Nonallergenic	5	10
	Allergenic, e.g., mahogany, teak	2.5	5
	Western red cedar (Nov/93)	1	5
ACGIH / TLV	Softwood, nonallergenic	5	10
	Certain hardwoods, as beech and oak	1	No STEL
OSHA/PEL	Wood dust	5	10
	Western red cedar	2.5	No STEL

WHMIS

Wood dust is currently exempt from WHMIS and no action is legally required when the IARC Monograph is published. Wood dust will be a controlled product when WHMIS II is incorporated into the Hazardous Products Act. A bill to amend the Act is scheduled for submission to Parliament in mid-1995 and regulations for the currently exempt products are expected to be published by the end of 1995.

NON-OCCUPATIONAL EXPOSURE

Many people work with wood at home. Building and refinishing furniture at home, for example, could result in exposure to fine, dry hardwood dusts that are mainly associated with the increased risk of sino-nasal cancer. Exposure to softwood dusts at home might result in higher exposure levels than in the workplace. However, non-occupational exposure would have continue for many years in dusty conditions to increase the risk of nasal cancer.

PRECAUTIONS

- Respirators with dust filters should be available for workers who wish to wear respiratory protection. A fabric/disposable dust respirator will provide sufficient protection (assigned protection factor of 5). An approved fabric respirator has two straps and both should be worn.
- Be careful when blowing dust from equipment and fixtures to avoid increasing workers' exposure. Whenever practical, use a vacuum or wet the dust for sweeping.

After exposure monitoring is done, the results will identify any areas where controls are needed to reduce dust concentrations and minimize workers' exposure. Depending on the concentrations measured and the jobs done, engineering controls may be needed, changes in work procedures may be required, or respiratory protection may be adequate for intermittent use.

FUTURE PUBLICATIONS AND ESTIMATED TIMING

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| · IARC Monograph on Wood Dust. | Spring 1995 |
| · CPPA. Risk Communication Package.
A series of training modules for risk communication. | Spring 1995 |
| · Johns Hopkins / AF&PA Study. Phase 1.
Results of a mortality study for US pulp and paper
mill employees with more than 10 years in the industry. | Summer 1995 |
| · BC Cancer Agency. Phase 1.
Results of the cohort study of mortality and morbidity
of BC pulp and paper mill workers. | Fall 1995 |
| · WCB: Recommended exposure limits for wood dust. | Fall 1995 |
| · BC Cancer Agency. Phase 2: Case-Control Study. | 1996
(approx.) |
| · IARC Study. An evaluation of cancer risks for pulp and paper mill workers,
a review of studies worldwide. | 1995++ |

FUTURE FIHRP BULLETINS

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| a. Air sampling methods and exposure monitoring strategies for total dust. | March 1995 |
| b. Risk assessment of pulp and paper mill workers exposure to measured concentrations of wood dust. | March or April 1995 |
| c. A question and answer bulletin on the most frequently asked questions. | April 1995 |
| d. A training package for health and safety meetings.
(Proposed - if sufficient demand from mills). | May 1995 |

REFERENCES

The following documents are included in the package available from the Pulp and Paper Forum.

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