Wood Dust Exposure Standards

- Managing Change

An International Perspective

Denise Clayton

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Denise Clayton

Personal Profile

Denise Clayton has been involved with the Victorian timber industry for ten years, through her employment with the Victorian Association of Forest Industries. She has been the Association's Occupational Health and Safety Coordinator since 1993.

The Victorian Association of Forest Industries has a broad membership base representing hardwood and softwood sawmills, loggers, harvesting companies and further processors.

The role of Occupational Health and Safety Coordinator is wide ranging and encompasses provision of advice and support to member organisations; workers compensation management; government liaison; field work and statewide project management. A number of recent initiatives has seen industry take on a coordinated approach to managing workplace safety across Victoria.

In 1996 Denise completed a research project into wood dust and it's associated health effects during post-graduate studies.

The Gottstein Fellowship has provided an excellent opportunity for Denise to continue researching the issue of wood dust, particularly how leading European countries are managing control strategies in the face of continual change.

This report provides Australia's timber industry with both information and guidance on how to manage wood dust control into the next millennium.

Denise has a Graduate Diploma in Occupational Hazard Management from VIOSH Australia, University of Ballarat.

ABSTRACT

This report summarizes current information concerning wood dust and the results of a European study tour, undertaken as a result of Gottstein Fellowship in 1998. The study tour visited Sweden, Denmark and the Netherlands.

The aim of the study tour, and subsequent report, is to provide Australia's timber industry with information and guidance on how to manage wood dust control in the workplace.

The report presents the known health effects of exposure to wood dust and the effects that Australian timbers may have on those working with them.

Although dermatitis can be a common health effect of handling timbers, of more concern are the respiratory effects known to be associated with wood dusts, particularly hardwood dusts. These respiratory problems include the following in varying degrees: asthma; alveolitis; rhinitis; bronchitis, airway disorders, irritations of the nose and eyes; wheezing and nasal itching. Prolonged exposure to hardwood dust can lead to mucostatis, which has been linked to the development of nasal and para-nasal cancers. Exposure to the volatile organic compounds – monoterpenes – found in softwoods can also lead to a variety of respiratory irritations. Whilst many of these health effects, such as asthma, bronchitis and rhinitis are common and may not be associated with a person's occupation, cancer of nasal and para-nasal sinus is relatively rare and can nearly always be directly related to occupation.

Current Australian industry practices regarding wood dust show there has been relatively little activity with regard to this issue. In 1994, in response to public and industry's concerns regarding exposure to wood dusts, the National Association of Forest Industries produced an information kit "Wood Product Safety Information". This kit was widely distributed and has proved a useful tool in the provision of information to industry, schools and the general public.

Most Australian employers are aware of, and utilise, appropriate extraction systems and process ventilation in the workplace to remove dust particles. Maintenance of these extraction and ventilation systems is of utmost importance to preserve their efficiency. Anecdotal evidence suggests that many systems are repaired and patched in ways that may not maintain the required standards.

The report also contains a summary of exposure standards for wood dust in both Australia and Europe, including impacts that directives from the European Economic Community may have in the future.

Findings show that the three (3) countries visited are all experiencing a period of change with regard to their wood dust exposure standards and this is a significant issue for each of them. Interestingly, regulatory bodies do not appear to have developed firm management strategies for addressing these changes. Employer groups are actively involved in research and projects focussed on reducing air borne wood dust, whilst trade unions are also heavily involved in wood dust related projects and employee education. Many of their projects are conducted in conjunction with employer groups and regulatory authorities. Key issues of importance for the next three (3) years are also outlined for each of the countries visited.

Case studies, detailing some of the projects employer groups and research facilities are undertaking, are in the report also. A number of photographic examples are included for the reader's information.

Seven recommendations are made at the conclusion of this report. The primary focus of the recommendations is to increase Australian industry's level of knowledge concerning wood dust, it's health effects and ways in which it can be managed in the workplace.

These recommendations include:

- national timber industry occupational health and safety committee;
- national training and education program for employers and employees;
- pilot monitoring and surveying program;
- existing Material Safety Data Sheets (developed in 1994) for Australian timber and manufactured products be reviewed and updated;
- literature review and further work be carried out on the issue of monoterpene exposure from softwoods;
- model purchasing specification for new wood processing equipment be developed in line with current legislative requirements;
- long term health monitoring program.

The current level of activity in the European community concerning wood dust sends a strong message that this issue cannot be disregarded by any country which processes and/or manufactures timber products. Wood dust, together with other occupational health and safety information, must be incorporated into leadership strategies of the future for the timber industry.

KEY WORDS: cancer; Denmark; dust; exposure; health effects; nasal; Netherlands; respiratory; skin; standards; Sweden; timber; ventilation; wood.

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1. Introduction

Workers in the timber industry are exposed to many hazards: excessive noise levels, manual handling sprains and strains; lacerations and crush injuries from materials handling and skin effects such as allergic contact dermatitis and irritant contact dermatitis. Poorly designed work stations, poor housekeeping and insufficient lighting can also influence the health and safety of timber industry workers.

Numerous authors have demonstrated that exposure to hardwood dust - particularly in an occupational setting - can and does induce a variety of respiratory problems. These respiratory problems include the following in varying degrees: asthma, alveolitis, rhinitis, bronchitis, airway disorders, irritation of the nose and eyes, wheezing, coughs, sneezing and nasal itching. Prolonged exposure to hardwood dust can lead to mucostatis which has been linked to the development of nasal and para-nasal cancers.

Whilst many of these health effects, such as asthma, bronchitis and rhinitis are common and may not be associated with a person's occupation, cancer of the nasal and para-nasal sinus is relatively rare and can nearly always be directly related to occupation. The incidence rate for such cancers have been recorded as 1 per 1 million people in the general population and 250 per 1 million for timber industry workers (Nylander and Dement, 1993 p.627).

In 1995 the International Agency for Research on Cancer (IARC) classified wood dust as a Group 1 carcinogen to humans. This classification is a result of a marked increase in the occurrence of cancer of the nasal cavities and para-nasal sinuses among workers exposed to hardwood dust.

Whilst the current exposure standard for hardwood dust in Australia is 1mg/m^3, monitoring survey results clearly indicate that many workers are exposed to much higher levels. Sawmill workers can and do have similar exposure levels to furniture producers and cabinet makers (cited in Nylander and Dement, 1993 p.622).

A previous study undertaken by this author has shown that whilst many papers and journal articles have been written about the health effects associated with exposure to hardwood dust there is not a lot of information available concerning best practice control strategies. Anecdotal evidence suggests that whilst many Australian employers are familiar with standard dust extraction systems, knowledge of alternative methods of dust extraction appear to be limited.

This study tour focused on Europe and in particular Sweden and Denmark for a number of reasons.

- Sweden and Denmark have a strong timber industry, providing employment to significant levels of their country's population.

- Both countries enjoy a solid reputation throughout the world for innovative and advanced technology and equipment design.

- Both are experiencing the process of change with reductions in their wood dust exposure levels recently introduced or planned for imminent introduction.

- The Netherlands was also selected for this study tour as they have recently had reductions in exposure standards for wood dust.

Specifically the author was keen to explore how the changes are being managed by the industry, employee representatives and the government, what best practice models are emerging as a result of these changes and how can Australia benefit from their experiences.

Concentrating on the European based timber industry also provided the author with the opportunity to observe and record information in three (3) different environments. Although these countries are close in proximity and have strong links, there existed difference and diversity that would not be possible if only one (1) country was visited.

Results and findings in this report focus on how the key stakeholders, being employer and employee representatives and regulatory authorities are managing wood dust control in the climate of change.

Keeping this in mind some of the information contained in this report has been drawn from environments where green sawmilling is not the predominant activity.

Similarly, each of the three (3) countries has only one (1) exposure standard for wood dust and does not differentiate between hard and soft woods. Therefore some case studies used are in a softwood processing environment. As the exposure standard is the same and it is the control principles that are being examined it was considered unnecessary to exclude any timbers or processing plants from this study tour.

Any cases involving the addition of chemical agents have been discounted however, as this report is limited to exposures to untreated wood dust only.

The findings of the study tour are discussed on the following pages together with some general information on wood dust, as we know it today.

2. Aims and Objectives

The aims of this study tour and subsequent report are:

- to summarise how European countries, specifically Sweden, Denmark and the Netherlands, are managing reductions in exposure standards for wood dust in the timber industry;
  and
- to provide Australia's timber industry with information and guidance on how to manage wood dust control.

The principal objectives, designed to meet these aims are:

1. Determine the health effects associated with exposure to wood dust.

2. Examine what factors have promoted national authorities to reduce exposure standards.

3. Identify how the European timber industry is managing significant changes to exposure standards.

4. Investigate how compliance with national standards is enforced and monitored.

5. Establish what currently is considered to be best practice in controlling wood dust exposure.

6. Provide recommendations for future directions.

3. Methodology

The methodology for this report was diverse and utilised a broad cross-section of research tools. Primarily however, the following methods were used to summarise how European countries, specifically Sweden, Denmark and the Netherlands are managing reductions in exposure standards for wood dust in the timber industry.

- **Literature searches of professional libraries**
  Literature searches were conducted of library catalogues at University of Ballarat and Royal Melbourne Institute of Technology. From these searches a number of journal articles were obtained.

  Searches of ACEL and OSHROM databases were conducted to obtain abstracts and journal articles. The Internet was also used as a tool to obtain information and contacts from overseas sources.

- **Interviews with professional contacts**
  Interviews and meetings with professional contacts were arranged in each of the three (3) countries visited.

A base questionnaire was prepared and utilised at each of these interviews of meetings. The range of professional contacts was diverse and encompassed employer associations, enterprises, unions, government agencies and occupational health and safety (OHS) consultants. A large amount of literature was also obtained during these face-to-face contacts.

4. Dust Particle Sizes

Tasks in the log sawmilling environment are varied and different plant produces different sized dust particles. Particles can be divided into two (2) categories, shavings and dust (Brooks, date unknown).

Shavings are large and will almost certainly drop straight to the floor whereas dusts have a finer consistency and may stay in the worker's breathing zone (around the head) to be inhaled into the body.

Of these dusts it is interesting to note that green timber particles have a tendency to drop to the floor more quickly than those of timber that has been kiln dried. This is influenced by the difference in moisture content between the two (Howell Brian – verbal conversation, 1995).

The particles that remain in the worker's breathing zone and are inhaled are known as inspirable fractions and can be affected by flow rates of the mouth and nose as well as external airflow. Inspirable particles range in diameter from 8 to 185 micrometers (µm). These particles are, in the main, deposited in the nose, pharynx and larynx. Particles ranging from 0 to 7 µm are known as respirable fractions. These dust particles are extremely fine and will deposit in the lower bronchi and alveolar regions of the lung. Some particles travel through the air, carried by air currents. Others however, are projected by the machinery being used.

Many woodworking machines eject particles back toward the operator. These can vary in size from inspirable fractions through to chips, depending upon timber and machine types. Many of operators work in close vicinity to their machinery (within a two metre zone) and are protected from large particles of material by screens or face shields. Unfortunately the stopping distance of both large and small particles can exceed this distance by up to 50 metres (Hamil, Ingle, Searle, Williams, 1991 p.398).

One study examined a number of workplaces using a Tyndall beam lamp and found that many machines not only generated a large amount of dust, but in fact, channeled it back toward the operator in a jet (Hamil et al, 1991 p.401). The machines observed to generate the higher concentrations of wood dust included circular saws, thicknessers, moulders and lathes.

This in turn greatly increases the amount of inspirable dust in the worker's breathing zone. In conclusion the report stated that machine type may influence the level of symptom experienced by the operator due to the higher quantities of particles entering the nasal cavity area (Hamil et al, 1991 p.400).

A 1993 Swedish report also noted that the use of 'tools' such as compressed air to clean down machinery can leave inspirable and respirable wood dust particles hanging in the worker's breathing zone for up to two (2) additional hours (Soderqvist, 1993).

5. Health Effects of Exposure to Wood Dust

There is a large variety of health effects associated with exposure to wood dust. These can be separated into two (2) distinct areas: skin effects and respiratory effects. Below is a brief summary of these health effects.

This information has been drawn from a wide literature search, including the IARC, Merck Manual of Diagnosis and Dorlands Illustrated Medical Dictionary. As this is a summary, individual references have not been made.

Skin Effects

Allergic Contact Dermatitis

Dermatitis can be characterized by an inflammation of the skin, accompanied by redness, scaling, itching and some oozing and crusting may occur. A re-exposure may be necessary to produce this reaction. Allergic contact dermatitis often affects workers handling green materials due to sensitizing chemicals in the heartwood.

Irritant Contact Dermatitis

Irritant contact dermatitis occurs by a different mechanism and does not require previous exposure to produce a reaction. Such reactions can include weals, rashes and pustules. Irritant contact dermatitis may be brought on through sap or bark contact. This particular type of dermatitis is extremely common in timber fallers with secondary infections common.

Contact Urticaria

Urticaria is a vascular reaction of the skin, marked by the appearance of weals and, occasionally, severe itching. Symptoms may disappear after 48 hours but can exist in chronic form. Symptoms appear after contact with the irritating agent.

Respiratory Effects

The respiratory system comprises airways, nasal cavity, pharynx, larynx, trachea and lungs: bronchial tree; alveolar sacs. Inspirable particles deposit in the airways while respirable particles are inhaled into the bronchi and alveolar sacs.

Extrinsic Allergic Alveolitis (EAA)

EAA is a respiratory hypersensitivity reaction and is induced by repeated inspiration of organic particles. These particles, whilst including hardwood dusts, can also include mould spores on green timber. Symptoms may not be noticeable until up to eight hours after initial exposure and can include the following: dry cough, fatigue, fever, chills, an accelerated pulse and excessively rapid breathing. Chronic symptoms are interstitial fibrosis and a thickening of the alveolar wall. Symptoms are reversible with cessation of exposure.

Organic Toxic Dust Syndrome (OTDS)

OTDS can also be induced by a microbiological component in wood dust such as fungal spores. The syndrome is characterized by an influenza-like symptom and may or may not include respiratory changes. Whilst cases of EAA are associated with repeated exposure to dust and mould spores OTDS appears linked to occasional heavy exposures to moldy dust, such as old wood chips.

Occupational Asthma

Occupational asthma is a condition marked by wheezing caused by spasmodic contraction of the bronchi. Symptoms may include: shortness of breath, tightness of the chest; a cough and on occasion sneezing and tearing.

These symptoms may not appear until after working hours which can make it difficult to associate with the working environment. Symptoms may disappear during extended absence from the working environment (weekends or holidays) and reappear upon resumption of work.

Occupational Rhinitis

Occupational Rhinitis is an inflammation of the mucous membrane of the nose. Symptoms may be similar to those of hay fever and include itching of the eyes, nose and pharynx. Sneezing and a clear watery discharge may come on followed later by asthma-like symptoms, e.g. coughing and wheezing. Frontal or 'sinus' headaches may also be experienced.

Occupational Chronic Bronchitis

Bronchitis is an inflammation of one or more of the bronchi. In an occupational setting it is brought on by the inhalation of an irritant substance. Symptoms include a cough, fever and pain in the chest when coughing. Chronic bronchitis occurs after repeated attacks of acute bronchitis and expectoration from the lungs. Symptoms are reversible with cessation of exposure.

Mucous Membrane Irritation Syndrome

MMIS can be characterised by burning, itching or tearing of the eyes along with sneezing and itching of the nose. The symptoms are generally brought about by entering a dusty environment.

Mucostatis

Mucostatis is the impairment of the mucocilliary escalator. This can result in reduced mucocilliary transport rates associated with exposure to wood dust. Such factors are considered to be a contributing factor in the development of nasal cancers due to the prolonged retention time of wood dust in the nasal cavity.

Prolonged mucosal contact with hardwood dust can initiate mucostatis and this has been linked to the development of nasal cancers. Long term exposures may lead to mucostatis and in turn nasal cancers.

The term cancer refers to the alteration of the genetic material in a cell within the body. This alteration results in a form of uncontrolled cell division and propagation. The development of a cancerous tumour is one outcome of such alterations.

Nasal and Para-Nasal Sinus Cancer

Cancer of the nose and para-nasal sinuses has quite specific symptoms; unilateral bloody discharge from the nose; nasal obstruction; facial swelling and numbness. The Mercks medical manual specifically identifies these combined symptoms as nasal cancer until proven otherwise. The nasal and para-nasal sinus area encompasses the nasal cavity and passages, sinuses and secondary sinus area.

Other Cancers

A number of authors have attempted to link hardwood dust exposure to other forms of cancer, these have included: Hodgkin's disease; tumours of the lymphatic system, gastrointestinal tract, skin, lung, stomach, colon and rectum. The IARC, after reviewing a wide range of data from many sources draw the conclusion that there is insufficient evidence to ascertain that exposure to wood dust has a causal role in the development of any of the above listed types of cancer.

Symptoms of exposure to hardwood dust can manifest in other forms apart from skin and respiratory ailments. Workers may experience headaches, nausea, giddiness, drowsiness, visual disturbance, muscle cramp and cardiac arrhythmia through contact with certain species of timbers. More specific associations can be found in the International Labour Organisation document Table of Poisonous, Allergenic and Biologically Active Wood Varieties.

From the available literature the following observations can be made with regard to nasal and para-nasal cancers.

- Males are at greater risk than females, and this can most likely be attributed to occupation.

- Coarse dusts from sawmills are just as hazardous to health as fine dusts generated during furniture production.

- Occurrence is predominately in patients between 45 - 68 years of age.

- Wood components are more significant in nasal and para-nasal cancers than chemical agents.

- There exists some indications that smoking may interact with exposure to increase the severity of the cancer.

- Survival rates are poor - in 1982 they were placed at 50 percent after two years.

- Exposures resulting in positive tests for cancer can range from 5 - 55 years and this may depend upon types of exposure and individual susceptibility.

- The latency period before tumour development is averaged at 40 years but can vary within a range of 7 - 70 years.

- If the development of mucostatis can be eliminated through appropriate control strategies, this may assist in the prevention of nasal and para-nasal cancers.

6. Australian Timbers and Health Effects

Exposure standards, both in Australia and overseas, include all species of hardwood timbers under the 'hardwood' umbrella. It is known however that some species are more reactive than others and these include timbers such as beech, oak, cedar and teak. All exposure standards and recommended practices in Australia and other countries are designed to protect workers from these timbers as well as those that may be less toxic.

Extensive research has been undertaken throughout Europe and the United States of America to establish the health effects and probable causes of such effects. The belief is that it is not chemical agents in the timbers that cause a reaction, but the natural components of the timbers. Such agents include waxes, resins, proteins, acids and tannin – identified by the IARC as a carcinogen.

Although a great deal of information has been published regarding hardwood dust exposure and the associated risks, there is limited information available on Australian species of timber. Of the available information regarding Australian hardwoods the primary health effects associated with the timber are asthma, bronchitis, conjunctivitis, sinusitis, rhinitis and dermatitis. As previously mentioned, an extensive table of timbers and identified health effects has been published by the International Labour Organisation.

The two most significant papers produced in this country are those by Ironside and Matthews, published in 1975 and Pisaniello, Connell and Muriale, published in 1991. Ironside and Matthews focused their work on the links between adenocarcinoma of the para-nasal sinuses and hardwood dust exposure. From a group of 18 patients, 7 cases (or 39 percent) involved some form of exposure to the dust. Pisaniello et al used control groups to monitor levels of exposure for a variety of occupations.

They discovered that woodworkers reported more eye, ear and nasal problems than the control group and were exposed to levels of dust that were well in excess of the Worksafe Australia Standard.

Incidence of nasal and para-nasal cancer is relatively low in the general population, specifically reported in 1977 at 1 per 1 million (Nylander and Dement, 1993 p.627). A 1982 report places the incidence of such cancers amongst wood workers at 250 per 1 million (Franklin, 1982 p.51). This high incidence amongst woodworkers has been directly attributed to hardwood dust exposure in a number of research papers including those mentioned previously.

Of particular note amongst these authors is the type of tumour that develops amongst woodworkers – adenocarcinoma. Adenocarcinoma is a specific type of tumour that causes less than 10 percent of all nasal cancer deaths. Franklin's Tasmanian research found an incidence of 65 percent and Victorian research reported a rate of 20 percent for woodworkers – both considerably higher than the general population.

7. Current Australian Industry Practices

In Australia to date, there has been relatively little activity with regard to wood dust. There are national exposure standards for hardwood and softwood dusts that are set by the National Occupational Health and Safety Commission (also known as Worksafe Australia). Exposure standards are addressed in more detail in the next section of the report. Apart from the articles previously mentioned, there is very little literature on wood dust that has an Australian basis.

As mentioned, there are regulatory exposure standards in place throughout Australia. The exposure standards for hard and soft woods are applicable Australia wide, and to all timbers used in Australia whether local or imported.

The enforcement of workplace health and safety regulations is the responsibility of state based authorities. These authorities include Victorian WorkCover Authority, NSW WorkCover Authority and Workplace Health & Safety in Queensland. These authorities also enforce national exposure standards.

Anecdotal evidence suggests that state based regulatory authorities are not conducting random sampling in workplaces. This is likely to be because sampling requires specialist skills and equipment; can be time-consuming and expensive. If a regulatory inspector was concerned about wood dust levels in a workplace they were visiting the most common approach is to direct the employer to undertake sampling. The employer would then be required to present the findings to the inspector together with risk assessment and management plans for the reduction in any levels found to be in excess of the national exposure standard.

It is common for employers, in consultation with their employees, to initiate the sampling process in order to manage wood dust levels and keep them under the national exposure standard.

State based employer bodies are responsible for assisting their member organisations with issues such as occupational health and safety (OHS). This is appropriate considering that, as previously noted, each state has its own regulatory body and different legislative requirements. The Victorian Association of Forest Industries and Timber Trade Industrial Association in New South Wales are the only employer groups in Australia that have full time OHS staff.

In 1994, in response to the public and industry's concerns regarding exposure to wood dusts the National Association of Forest Industries, through the National Hardwood Forum and in conjunction with state employer groups, held an information day and produced an information kit.

The kit, "Wood Product Safety Information", contained a number of generic Material Safety Data Sheets (MSDS) together with general information concerning other hazards associated with wood. For the reader's information the MSDS for Australian Hardwood is available from the National Association of Forest Industries. Since this information kit appeared in 1994 it has not been updated, nor have additional materials been developed at a national level.

In Victoria we receive regular requests for educational information from schools, contract builders and others who have an awareness of, or interest in, wood dust management. The Wood Product Safety Information kit has proved a useful tool in the provision of this information.

Most employers are aware of the need for appropriate extraction systems and process ventilation when installing or purchasing new equipment. One of the biggest issues that employers do need to be aware of is maintaining these systems in top condition to ensure they continue to perform as they were designed to. Unfortunately, it is not unusual to see extraction lines damaged, torn, punctured or held together with tape. All these things can greatly affect the efficiency of the system and allow excessive amounts of wood dust to enter the workplace.

The CFMEU, Forest and Forest Products Division appear to obtain much of their wood dust related information from the International Federation of Building and Wood Workers (IFBWW). This information appears to be current and user-friendly as the IFBWW, through their affiliations, are involved in a number of wood dust related campaigns throughout Europe.

To the author's knowledge, the CFMEU, Forest & Forest Products Division has not undertaken any specific education campaigns for its members concerning wood dust.

8. Exposure Standards

Australia

The exposure standard in Australia for hardwood dust is 1 milligram per cubic metre (mg/m^3) for a time weighted average (TWA) concentration and $5mg/m^3$ for softwood. A TWA is the average concentration for an eight (8) hour working day for a five (5) day working week. This figure is indicative of exposure that almost all workers may be exposed to without adverse affect. Many other countries have considerably higher exposure standards for hardwood dust. The United Kingdom has an exposure standard of $5mg/m^3$. Until 1994 the Netherlands had a figure of $5mg/m^3$, it was recently recommended that a level of $2mg/m^3$ be introduced to reduce health effects associated with exposures. The United States of America currently has an exposure standard of the same quantities as Australia, that being $1mg/m^3$ for hardwood and $5mg/m^3$ for softwood.

A number of authors have, during the course of their research, undertaken monitoring surveys to determine the dust exposure levels of wood workers. Of the six (6) reports examined the majority of samples was found to exceed the Australian exposure standard of $1mg/m^3$. A table of the findings of such authors appears as Appendix 2 of the report. Two (2) specific hardwood monitoring surveys undertaken in 1994 and 1995 demonstrate indicative excess levels of exposure, particularly in work areas where further processing is undertaken. Report 1 found that 7 percent of employees were exposed to excess levels whilst Report 2 found that 80 percent of employees were exposed to excess levels. These findings demonstrate that a large proportion of sawmill employees are being exposed to levels of hardwood dust that exceed the Worksafe Australia Standard.

The observation has been made that the Australian timber industry will find it difficult to use the hardwood dust exposure standards of $1mg/m^3$ as a realistic regulatory limit (Hughes, 1990 p.13). Anecdotal evidence combined with the above monitoring results reinforces this observation.

As previously mentioned, in 1995 the IARC classified wood dust as a Group 1 carcinogen to humans. A Group 1 carcinogen is defined by exposure circumstances entailing an exposure that is carcinogenic to humans. Use of such substances must be controlled to the highest possible standard by applying a conventional hierarchy of controls. Specifically, engineering solutions to reduce workers exposure should be implemented, supplemented by Personal Protective Equipment (PPE) where necessary.

A 1993 Swedish report suggests that it may be possible for irritations and onset of health effects to be related to the total surface area of the dust, rather than the weight of the dust in the air. It was anecdotally noted that many sawmill operators experience noticeable respiratory problems despite having dust exposures of below the national standard. Although no scientific conclusions can be drawn from this information it is interesting to note.

Europe

The European Economic Community or Union (EU) as it is now known, comprises 15 countries. The original goal of the EU was to develop a more stable economic situation whilst providing free movement of "*goods, persons, services and capital*" within the community. Although high profile activities of the EU such as the euro-currency and European parliament are well documented, OHS issues are also addressed on a community scale.

Since 1990 the EU has been developing policies regarding the protection of workers from exposure to carcinogens at work. One area they have spent a great deal of time on is that of wood dust. Following the IARC reclassification of wood dust as a Group 1 carcinogen the EU Scientific Committee prepared a statement concurring with these findings - highlighting beech and oak dusts but unable to exclude other types of hardwood dust as cancer forming agents.

Individual countries can set their own wood dust exposure limits, including all members of the EU. Once however, the EU set a European limit then all members must meet this limit. Individual member countries can still impose their own limit values - but they cannot exceed the set EU limit.

In March 1998 the EU released a proposal that put forward a common position on some of the issues related to use of carcinogens in the workplace. In it's comments on wood dust the proposal accepted beech and oak dust as carcinogenic but believed more scientific work was required to include other types of wood. They also sought to define a scientifically based figure which would reflect the lowest acceptable risk.

On the basis of current advice from member states (whose levels vary from 2 - 10mg/m^3) the EU set a community exposure standard of 5mg/m^3. The EU believe this to be an appropriate indication of minimum standards for good technological practice, but have stated that this figure should be reviewed within five (5) years in order to align it with the most recent scientific data on health and safety of workers.

In December 1997 the Employers Federation of Swedish Forest Industries and Employers Association of the Swedish Wood Products Industry presented a submission to the EU on the proposed Directive. Their concerns related to the singling out of beech and oak in the Directive as both are widely used throughout the industry. They also made objections to points relating to the substitution of carcinogens with other materials, arguing that clearly this was not a viable option for the forest products industry.

In September, 1998 the European Federation of Building & Wood Workers (EFBWW) released their wood dust policy. This followed their rejection of the proposal for the abovementioned Council Directive. Their two (2) major points of disagreement were detailed in this policy.

Dusts from all sorts of wood must be included in the Carcinogenic Directive.

The belief of the EFBWW being it will be difficult to accurately regulate particular types of wood where it is common to use a number of species, and current studies do not acquit any wood dusts for carcinogenic potential.

The limit value must be 1mg/m^3.

The EFBWW highlighted the fact that the EU admitted in their proposal to being unable to set a scientifically based occupational limit which could provide a validated level of protection.

The EFBWW also believe it is doubtful a limit value of 5mg/m^3 would provide an acceptable level of protection. More than half the community members already had exposure standards set well below the proposed figure. A table of these standards appears as Appendix 3.

At the time of this study tour the EU Directive was to be introduced, without the requested amendments during 1999.

Some organisations (particularly unions) have been critical of the EU, believing that although they provide a social dialogue and perhaps more influence to social parties, at the OHS level they are not functioning as cohesively as they could be.

Clearly, meeting these community standards will pose no problem for the countries involved in this study, however the issue of EU Directives on workplace standards does raise a number of questions.

There is no doubt that the introduction of community standards will improve working conditions in countries like Italy, Portugal and Spain where national standards are set at 10mg/m^3. What should be of concern to the EU and it's members is the clear evidence from a number of scientific groups about the level of protection a limit value of 5mg/m^3 provides to operators.

The EU Scientific Expert Group on Occupational Exposure Limits notes in one of it's articles, "*as a possible explanation the authors mention the different level of exposure to wood dust and assume that, if a time-weighted eight (8) hour average of 5mg/m^3 is adhered to the cancer risk from wood dust could be avoided. Although this is pure speculation*…" (emphasis added).

With countries like Sweden, Austria and Germany introducing even lower national standards than those currently set, is a community level of 5mg/m^3 adequate to protect workers from the carcinogenic effects of wood dust exposure?

Appearing as Figure 1 is a table of current exposure standards.

Current Wood Dust Exposure Standards

Country	**Hardwood (mg/m^3)**	**Softwood (mg/m^3)**	**Previous (mg/m^3)**
Australia	1.0	5.0	-
United Kingdom	5.0	5.0	-
USA	1.0	5.0	-
Netherlands	2.0	2.0	5.0 prior to '95
Sweden	2.0	2.0	5.0 prior early 80's
Denmark	2.0	2.0	-

Figure 1.

9. Findings

This study tour encompassed three (3) countries and 20 site visits and interviews. Meetings were held with the employer groups, relevant trade unions and regulatory authorities as well as individual organisations, OHS consultants and training providers.

Below is a brief summary of the findings.

- Wood dust is a key issue for employers and unions in all three (3) countries visited.

- The Netherlands reduced its exposure standard from 5.0mg/m^3 to 2.0mg/m^3 in 1995. This provided a three (3) year phase in for employers with the lower standard only applicable for new equipment. Across the board application comes into force during 1999.

- Sweden's exposure standard was reduced from 5.0mg/m^3 to 2.0mg/m^3 in the 1980's. All new equipment, however must meet an exposure standard of 1.0mg/m^3. Consultation and review are likely to see this become the new exposure standard for all equipment and workplaces during 1999.

- Denmark has had an exposure standard of 2.0mg/m^3 for some time. During 1999 the regulatory authority wishes to lower the standard. Although not officially set, it is widely believed that the current exposure standard will be halved to 1.0mg/m^3 and apply to all equipment and workplaces.

- All three (3) countries have recently completed major research projects into controlling and managing wood dust.

- These projects have been completed by industry funded research facilities or consultants with results being available to those employers who are members of the relevant employer group.

- Regulatory authorities do not, in the main, have clearly defined strategies for the management of changes in national exposure standards for wood dust.

- Trade unions have an active role in addressing a wide range of OHS issues including wood dust. In many instances this is undertaken in conjunction with employer representatives.

Regulatory Authorities

Meetings and discussions were held with regulatory authorities in each of the countries visited. All three (3) have a similar structure to those existing in many Australian states, particularly Victoria, New South Wales and Queensland. A central body oversees regional offices with local inspectors to visit employers. Trade union liaison is conducted through head office.

The most obvious difference between these countries and Australia is that all legislation and regulations have a national focus. Although countries are divided into regions these are not formally recognised as separately administered states, such as Australia is, providing a cohesive approach to regulatory matters.

The focus, particularly in Denmark, is on a self-regulatory approach to OHS issues in the workplace. Inspectors have an overseeing role and do not appear to be actively involved in 'case managing' individual employers.

Denmark and the Netherlands also have a legislative requirement for certain employer types and sizes to engage professional assistance in managing OHS issues. The Danish must pay for the service but do not have to utilise it, whilst the Dutch employers must pay for and utilise the service to address six (6) OHS issues in the workplace as a minimum. This is why case managing poor performing industries or employers is not an issue for the regulatory authorities.

The Danish regulatory authority (DWES), together with trade unions and employer groups, are currently approaching equipment manufacturers to encourage them to develop solutions that control wood dust at the source. By doing this it will assist employers to meet legislative requirements whilst providing a cleaner and safer working environment.

The Swedish regulatory authority is interested in the release of volatile organic compounds from sawn softwoods. These organic compounds are known as monoterpenes and in Sweden have an exposure standard of 150mg/m^3. Monoterpenes are sensitizing to humans and known to irritate the lungs and airways.

A set of protocols and criteria are currently being prepared to address and control exposures to monoterpenes in the workplace. With identification of this issue being quite recent, papers and articles available to date appear to only address the acute effects of exposure. Further research will have to be done before an accurate profile of the chronic effects can be developed.

All three (3) countries are experiencing a period of change with exposure standards. All are looking to introduce lower exposure standards than those currently in place. A process of consultation with key stakeholders and wood dust sampling projects will be carried out prior to introductions of change. However, from the discussions held it is clear that, without preempting the results of the planned processes, the changes will go ahead. What was also clear during the discussions was that none of the regulatory bodies has a formulated strategy for managing the issues surrounding such a change, beyond initial consultations. Denmark plans to run some campaigns to educate employers on the changes as do Sweden but do not have any specific detail available.

The Netherlands, with their three (3) years phase-in period, has already had ample time to educate industry about the changes taking place. The government provides substantial tax breaks for investments in new equipment and substantial improvements to the workplace. Many timber industry employers have utilised the tax break scheme for purchasing new equipment to meet these legislative requirements and the scheme is considered to be very successful.

Employer groups, trade unions and OHS consultants believe that when changes are introduced employers will need to conduct wood dust monitoring within their workplaces to ensure they are in compliance with the new exposure standards. This could lead to considerable expense for the employers, particularly if alterations are needed at the workplace to meet the new standards.

Employer Groups

Employer groups are extremely active in the three (3) countries, providing a focal point for OHS and economic issues relating to the timber industry. In this the industries are very similar to the state based employer groups within Australia.

Netherlands

The major employer group is the Verniging Van Nederlands Houtondernemingen (VVNH) for the sawmilling and further processing sectors. The have approximately 250 members across the country, representing 90 percent of the industry. The VVNH have a staff of 15 and provide a range of services including legal advice, industrial relations, economics and OHS. They also set trade prices for the country.

The VVNH have a four (4) year contract with an accredited OHS consultant, ARBOTECH, for the benefit of their members. ARBOTECH were chosen for their experience in the timber industry and expertise with manual handling injuries. Currently, manual handling injuries account for 60 percent of all work related incidents in the Netherlands timber industry.

ARBOTECH have been working on a number of industry projects recently, including:

- Safe sawmill project (two year duration);

- Insulating a moulder extraction system utilising 22mm medium density fibreboard as the primary material. This project led to a reduction in noise levels at the operator from 110dBA to 75dBA. The current exposure standard for noise in the Netherlands is set at 80 - 85dBA. This means the operator no longer requires hearing protection during operation, provided all outlets are closed and the insulated housing is maintained in good condition.

- Enclosing a bandsaw with removable covers. This project is discussed in more detail as part of the Netherlands case study.

Denmark

The major employer group in Denmark is the Confederation of Danish Industries (CDI). With a membership of 4,300 organisations, the 357 companies involved in wood and furniture production comprise 8.30 percent of total membership.

The timber industry demonstrates a strong commitment to research and development through the Danish Technological Institute - Centre for Wood Technology (DTI).

The DTI's primary focus is on assisting industry to improve safety standards. This includes the following:

- technological advances;
- indoor climate emissions;
- chemical leaching from product.

A considerable amount of time and resources is also devoted to the collection of best practice examples from a wide range of industry sectors.

The DTI receives 10 percent of its income from government funding. The remainder of its budget must be sourced from industry or other groups. A significant proportion of its work is performed in conjunction with other institutions such as universities.

Some of the DTI's projects are included in the Danish case studies.

Sweden

ARBIO are the major national employer group in Sweden and comprises three affiliated employer associations:

- **SLA -** Federation of Swedish Forestry and Agricultural Employers
  - forestry, agriculture, professional gardening and associated occupations
- **SSIF -** Employers Federation of Swedish Forest Industries
  - pulp and paper industry, sawmilling and manufactured products (mdf etc)
- **TIF -** Employers Association of the Swedish Wood Products Industry
  - furniture, joinery and prefabrication

The SSIF currently has 260 sawmill and manufacturing members. This figure represents 65 percent of the industry; 85 percent of all employees in these sectors and 90 percent of total related product in the country. They also have 80 pulp and paper members with 35,000 employees. The SLA have 3,335 members (26,200 employees) and the TIF 700 members (30,000 employees). All three organisations are actively involved in OHS related issues and activities.

The sawmilling/manufacturing sectors of the timber industry in Sweden have the highest accident rate of all industries, after emergency services. SSIF is currently developing a project profile in an attempt to reduce the accident rate by 30 percent over the next three years.

The timber industry also has a strong commitment to training and research & development through an industry funded centre.

Tratek - Swedish Institute of Wood Technology

Tratek is focussed on three (3) primary objectives for the Swedish timber industry:

- Research and development advances;
- Competitiveness;
- Profitability.

Tratek has 80 employees and three (3) offices throughout Sweden. It services all sectors of the timber industry from sawmilling through to advanced componentry and manufactured board producers. Funding for the organisation is provided through a compulsory fee paid on cubic metre volume and contributions from the government. Industry contributions account for 57 percent of Tratek's funding, whilst government contribute the remaining 43 percent.

The centre has spent a considerable amount of time and resources developing technology and control measures for reducing the amounts of wood dust and noise in the workplace. Some of these projects are discussed in detail further in the case study for Sweden.

Trade Unions

Trade unions appear to have a strong influence, particularly in the Netherlands, on OHS issues. All countries are involved in cooperative ventures with trade unions and regulatory authorities for OHS issues.

In 1995 the Netherlands lowered their exposure standard for wood dust. Mounting evidence at this time from groups such as the IARC and the EU highlighted the importance of reviewing the exposure standard. Government lobbying by the relevant trade unions also played a significant part in eventually having the standard lowered. Although the actual number of cases of para-nasal cancer appears to be relatively low in the Netherlands, the unions were successful in using hypothetical cases and social costs to argue their case. They also pushed the public image and product quality angles during their campaign.

Following the successful reduction in the national exposure standard, unions and regulatory authorities are currently completing a data collection program in order to create an accurate picture of illness and symptoms associated with exposure to wood dusts in an occupational setting. Data collected to date has identified carpentry as a 'problem' area to be addressed in the near future.

The Danish Wood Workers Union (TIB) represent the interests of approximately 70,000 members. 50 percent of these members are employed in the sawmilling and further processing areas, the remaining 50 percent in a variety of specialised trades (carpenters etc) within the construction area.

The TIB have a large staff to service their membership, including four (4) full time health and safety officers and a social worker.

The TIB, together with the CDI, has formed a number of committees at a national level to address issues such as:

- accident reduction
- ergonomics
- wood dust
- chemical use
- noise
- training programs
- air recirculation

These national groups have a purely advisory role with regard to these issues. Some sectors of industry have embraced the role and advice of these groups whilst others have been more reluctant to recognise the role they could play.

One project currently being prepared by the TIB and the DWES is the creation of an information sheet on the five (5) most common pieces of sawmilling equipment used in Denmark. The aim of this project is to highlight the noise levels of each piece of machinery. The authority and the union are keen to see purchasers consider safety issues when buying new equipment and are hopeful that this public "outing" will encourage manufacturers to improve the standard of safety mechanisms.

Unfortunately, during my visit to Sweden the trade unions were involved in a national conference and were unavailable. The regulatory bodies, however, expressed their intention to consult extensively with both the trade unions and employer groups prior to lowering the exposure standard. Discussions with the employer groups did not indicate a close working relationship between the two parties.

Key Issues of Importance to European Forest Industries

Wood dust is an issue that employers, employees and their representatives take very seriously. In the past large proportions of time and money have been devoted to addressing the issues associated with wood dust. As demonstrated in the included case studies, this work has been extremely fruitful in many cases with successful solutions to many problems being implemented.

In addition to wood dust and the control of ventilation in workplaces there are a number of key issues that will be prioritised for the next three (3) years in each country.

Accident Reduction

Reducing current accident rates has been identified as the top priority project for both Sweden and Denmark. The ARBIO in Sweden have set an accident reduction target of 30 percent over the next three years. Tratek will be working with ARBIO to meet this target.

The DWES are initiating tripartite discussions to develop strategies for the reduction of accidents in the timber industry. The TIB has also identified this as its top priority for the coming two years with targets set at a 50 percent reduction in accidents by the year 2000. The CDI is currently preparing a campaign to address machinery safety in an attempt to control accident rates.

In Australia many of these issues have also been identified as having direct impact on business operations. Accident reductions can lead to decreased costs in workers compensation claims, machinery repairs, downtime and employee replacement.

Manual Handling

The national OHS coordinator for the Netherlands timber industry is currently preparing a major project to address manual handling within the industry. 60 percent of all claims received by industry are related to manual handling sprains and strains.

In Denmark employer, employee bodies and the DWES all acknowledge that manual handling and ergonomics are priorities that must be addressed in the next few years. The TIB in particular appear to be very active in the education of workers regarding this issue.

Manual handling is also a significant problem for Australia's timber industry. Sprain and strain injuries continue to account for a large percentage of workers compensation claims throughout Australia.

Noise

As with Australia's industry noise is a major problem in all the countries visited for this report. The DWES are addressing this through two avenues. The first is tripartite discussions with employer and employee organisations. The second is the public listing of equipment and current noise levels. This has been done in an attempt to educate the consumer and encourage informed choice; and to drive the manufacturer to address noise level reductions at the design and manufacturing stages.

In Sweden noise is a high priority issue. Where possible wood dust control and noise solutions are developed in conjunction with each other. The benefits of addressing these issues together are clearly demonstrated in the case studies.

In previous years Australian employers have also had to contend with large numbers of workers compensation claims for noise-induced hearing loss. In Victoria claims peaked during the 1993/94 financial year prior to the introduction of threshold limits for noise induced hearing loss related claims.

By-product Emissions

Both Sweden and the Netherlands are making a concerted effort to reduce the amount of solvents being used (and emitted) by their respective timber industries.

Swedish law forbids the use of solvent based products where a viable (not necessarily affordable) alternative is available. One Ikea veneering plant uses non-solvent products for processing and laminating beech veneer. They currently use solvent products for their oak veneer as there is no viable alternative. However, it is interesting to note that the government agency requires the company to create a plan detailing how it will address this in the future, including timelines for the phasing out of the solvents.

In the Netherlands the government agency is aggressively pursuing this issue. It has reached a voluntary agreement with carpenters to reduce solvent use (or use solvent-free products by the year 2000. The agency is currently talking with other sectors of the wood and furnishing industry to ensure a similar agreement is reached. Regulations are planned at a later date to 'complement' these voluntary agreements.

Cost Effective Heating

Due to the extreme temperatures experienced in Denmark and Sweden during the winter months (-35 is the average temperature for much of the winter in Sweden's north) cost effective heating methods are always a high priority.

Temperatures this low not only affect employees but can freeze dust and waste matter to boards and extraction units. Large amounts of energy are used to rewarm dusts from freezing point. Tratek in Sweden is currently working on a project controlling airflows to reduce the amount of energy used during waste removal.

Obviously, our timber industry enjoys Australia's extremely mild climate and issues surrounding cost effective heating are not of paramount importance to us. However, particularly in Sweden, energy costs have a great impact on the costs associated with operating an enterprise and employers are keenly awaiting the outcomes of the current projects attempting to address this problem.

Indoor Air Quality

Again, related indirectly to energy costs, Sweden and Denmark also have a high level of concern regarding indoor air quality.

In Denmark it is illegal to recirculate indoor air in any industry. Exceptions to this are where a closed ventilation system exists and the air is going to a "machine only" area or where an organisation has received a special dispensation.

Extensive tripartite discussions are underway in an attempt to set regulations and guidelines for the possible recirculation of indoor air. These discussions will focus on the quality of such air and the impact that carcinogenic determinations by the IARC will have on the feasibility of such a project.

As more and more totally enclosed sawmills and processing plants are being built in Australia indoor air quality is becoming more of an issue. It will be interesting to watch the outcomes of the Danish discussions in particular.

10. Case Studies

Netherlands

Company Name: *Houthandel Vries*

Location: *Groningen, Netherlands*

Employees: *65*

Predominant Activities: *Resawing and moulding timber for standard stock and customer orders.*

Primary Equipment: *Bandsaw x 2*
Weinig moulder x 4

Background

With 50 employees on the shopfloor health and safety issues are important to Houthandel Vries.

The company has a documented strategy for the management of employee related issues and a collective agreement with the workforce that commits all parties to a reduction in lost time.

A number of programs and changes have been introduced into the workplace including:

- yearly safety “refresher” training for all staff;
- product with highest turnover is kept accessible and at reasonable heights in storage racks to reduce manual handling injuries;
- team lifting of large slab product;
- electric forklifts are used to keep plant noise levels as low as possible;
- employee consultation regarding changes to work processes and environment.

Two particular areas that the company has been working to improve are the removal of wood dust from the atmosphere and the reduction of machine noise levels.

Description

ARBOTECH, on behalf of VVNH, have been working with Houthandel Vries on reducing noise and dust levels on select pieces of equipment.

This long term project was jointly funded by Houthandel Vries and the industry sector, through the VVNH. The use of industry sector funds for a company specific project is acceptable on the understanding that results and outcomes belong in the public domain and are not the property of the individual company.

This particular project has been concentrated in the 'refining shed' where all of the primary equipment is housed.

The four (4) Weinig moulders run at parallel lines along the length of the shed, whilst the bandsaws sit in the middle of the area. The bandsaws are used for the resawing that may be required.

Exposure standards for noise are currently set between 80dBA and 85dBA, depending upon the age of the equipment. Houthandel Vries recognised that the noise levels on the equipment listed above was in excess of the prescribed amount and needed to be addressed. Previous readings had indicated noise levels of around the 110 dBA region. There had also been some problems with wood dust in the enclosed working environment.

It was decided that two (2) of the moulders and the bandsaws would be enclosed to lower noise exposure in the refining shed.

The two moulders and bandsaws were enclosed utilising a steel casing with 22mm medium density fibreboard as an insulating material. This was designed to have a two-fold effect:

1. to ensure that the noise was encapsulated at the machine;
2. to capture the wood dust in the enclosure for extraction.

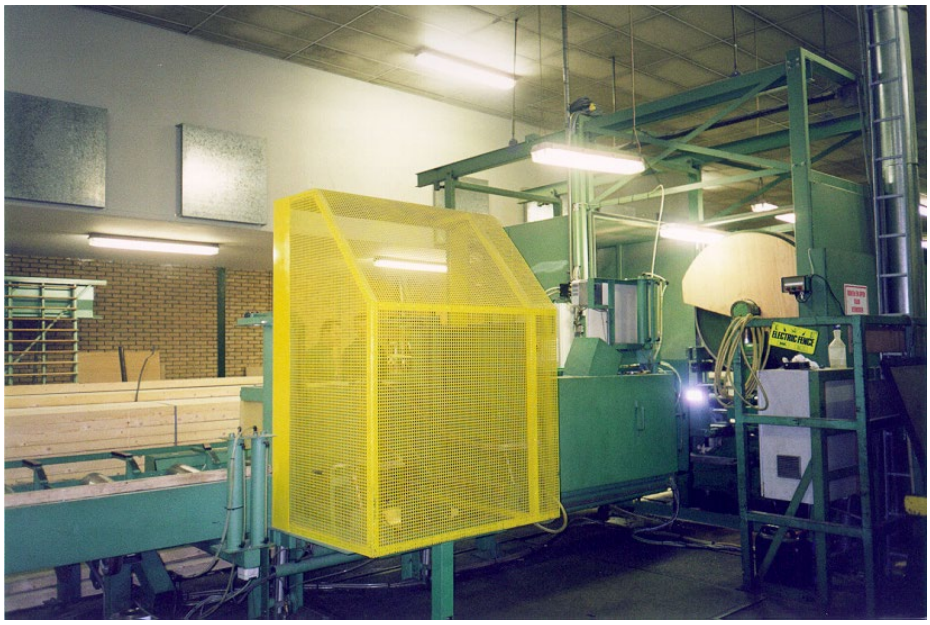
To further ensure that noise was reduced as far as practicable extraction pipes were directed straight up into the ceiling, which had been lined with insulating materials. To further reduce the noise in the work area all extraction fan and blower motors were relocated outside the building.

In order to make implementation of the changes a success in the workplace it was considered essential that the enclosure did not hamper maintenance or any adjustments that might need to occur during the normal working day. Accordingly, the following measures were incorporated within the new designs.

- Each of the enclosures has viewing windows and large access doors for monitoring the production process.
- Dust extraction equipment and pipes were incorporated into the housing to ensure they were not removed or tampered with.
- The machine housing for the moulders ensures reasonable working space around the machines for maintenance, repairs and freeing of jammed timber.
- The housing around the bandsaws is joined together by hydraulic pressure. To access the machines to change blades or make adjustments the pressure is released and the casing moves apart automatically on overhead tracking. Having the tracking overhead eliminates any tripping hazards that may arise from setting track runners onto the floor. The casing moves back sufficiently to allow blade changing and maintenance work to be performed in a safe manner.

: The bandsaw casing prior to being opened

Operator initiating the opening of the bandsaw casing



Casing opened to allow access to saw blades and moving parts

Efficiency of the dust extraction system means little wood dust on or around the machine.

Whilst introducing these measures did reduce both the dust and noise levels substantially, both ARBOTECH and Houthandel Vries felt that the noise reductions were not as significant as expected. Further investigative work was undertaken by ARBOTECH in order to pinpoint why the noise reductions were not greater.

It was discovered that a sizeable portion of noise was travelling down the timber as it exited the housing. This in effect meant that the timber was acting as a conductor for the noise. Further works were completed on the bandsaws and moulder housing in an effort to reduce the noise levels even further.

The most effective solution was to introduce a rubber strip cover along the length of the outfeed. This was attached to a frame and operated on a hydraulic system. During the sawing/moulding process the rubber strip remains in place, covering and insulating the outfeed.

When the timber has fully exited the housing an electronic eye activates the hydraulics to lift the rubber strip and the timber exits the outfeed onto the chains. Once the piece of timber is clear of the outfeed the hydraulics return the rubber strip cover to it's original position to await the next piece of timber. The use of electronic eyes has reduced the need for the operator to be in constant visual contact with the saw / blades and timber.

Rubber Strip Cover on the outfeed of the bandsaw,
closed whilst timber exits the machine and casing.

Electronic eye activates the hydraulic lift for the rubber strip cover

Hydraulics return the rubber strip cover to original position

Benefits

Wood dust is removed at the source and is not entering the operator breathing zone at any of the enclosed machines. The additional insulation also assists in keeping the dust levels down.

Noise levels have been reduced substantially. Recent readings at the infeed operator and outfeed chains have indicated noise levels of around the 75 dBA region. This is a substantial reduction in the noise levels and brings them under the regulated level, meaning that hearing protection is not required for normal operations at these machines. Because two (2) of the moulders remain unaltered it is still necessary for all operators in the refining shed to have some hearing protection with them at all times. However if only the enclosed machines are operating it is not necessary for these operators to wear hearing protection.

This project has also provided the added bonus of employee satisfaction in the workplace. All employees can recognise the time, expense and effort that has gone into making the working environment safer for everyone.

As previously mentioned the Netherlands government is very focussed on best practice with regard to equipment and technological developments. The current noise regulations are set at between 80 and 85 dBA. With the advent of these new noise control measures reducing the noise levels at the bandsaws and moulders to well below the prescribed standard, it is anticipated that these will very shortly become the 'state-of-the-art' benchmark that all similar equipment will be judged against.

Although the above case study had as it's primary focus, noise reduction measures, reducing the amount of wood dust in the enclosed work area was also a major objective. During the site visit most of the enclosed equipment was operating and there was no noticeable wood dust in the air. Unfortunately there was no wood dust sampling taken prior to commencement of the project so it is difficult to ascertain how significant the wood dust reductions have been. Anecdotal and employee evidence has suggested that there is a considerable and noticeable difference in the working environment since the changes have been introduced.

Sweden

Within Sweden there are two (2) major strategies for addressing the issues surrounding wood dust in the working environment:

- Low impulse ventilation
- Process ventilation

Ventilation refers to the movement and exchange of air to obtain better air quality. A number of projects have been undertaken using these strategies. Some have been funded by the Swedish Work Environment, others primarily by industry through Tratek. Rather than using a specific case study to demonstrate these projects, some examples and explanations of the strategies are given.

Low Impulse Ventilation

Low impulse ventilation, or displacement ventilation works by emitting clean air at low velocities over a large surface (Figure 2). It is successfully used over operators or work stations in a controlled environment.

This form of ventilation does not remove the air pollutant from the environment totally, rather the current flow prevents the dust from being stirred up into the operator's breathing zone.

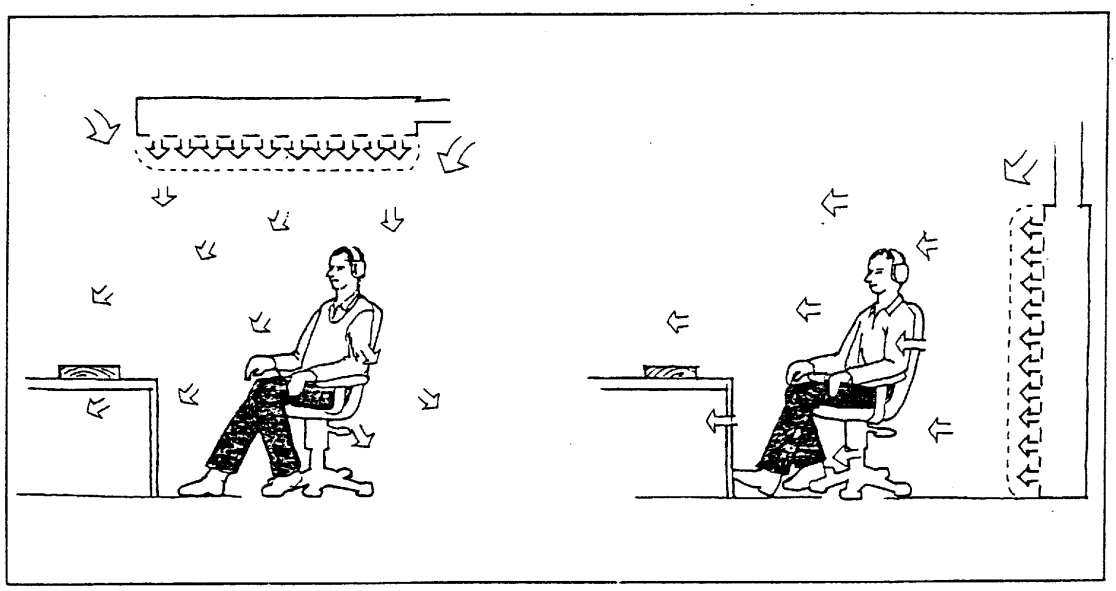


Figure 2.

The following, Figure 3, demonstrates the positive impact low impulse ventilation can have on the work environment.

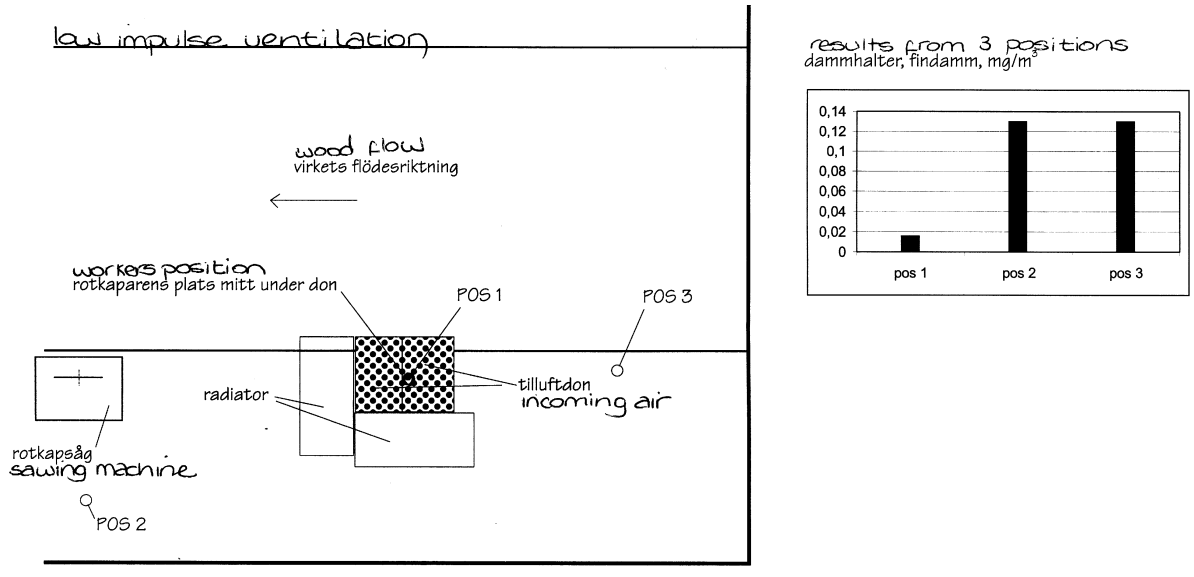


Figure 3.

Although all exposures are below the national standard on this profiling line, low impulse ventilation was introduced to improve it even further.

Readings at positions two (2) and three (3) are identical. The operator at position 1 was placed under the ventilation outlet. As the results show the amount of dust this operator was exposed to was almost negligible.

Whilst low impulse ventilation can be used successfully in a sawmill environment it does rely on a number of factors remaining consistent.

- Building must be relatively draught-free.
- Air intake vents must have large surface areas.
- Temperature of the intake air should be slightly less than the indoor air temperature. Too cool however, and the air will increase speed in order to sink to ground level, creating a feeling of draught.
- Conveyors or blowers/fans should not disturb the circulation of air, nor the layer of air at floor level.

In Sweden where most sawmills are totally enclosed and climate control is a significant issue (as it is in the Netherlands and Denmark) low impulse ventilation can be used successfully in the control of wood dust. In Australia, where many sawmills are open to the weather, the introduction of low impulse ventilation would have little success in reducing exposure of operators to wood dust. However, as more sawmills and processing plants are enclosed low impulse ventilation will become an option to be considered.

Process ventilation is often a more effective option for Australian sawmills than low impulse ventilation for many of the reasons listed above.

Process Ventilation

Process ventilation refers to the collection of air and pollutants at the source and transferring them away from the operator and the work environment. This is commonly achieved through a controlled air extraction system. This type of system is extensively used throughout Australia.

The Swedish sawmill industry invests large amounts of money in improving ventilation in the workplace. In 1980 the industry invested SEK300,000, by 1995 it was over SEK3 million just on ventilation. OHS experts involved in Swedish Work Environment Fund projects noted however that there appeared to be no changes or reductions in the levels of dust. They firmly believed that dust levels are related to production outputs, not ventilation investment dollars.

A project was undertaken to examine why the dust particles were in the air and how they were getting there. Complimentary to work done by Tratek it was found that air streams were forcing the particles into the atmosphere.

At the infeed, outfeed and places in between there can be many air streams. Sealing off the outgoing air streams did not reduce the amount of dust particles, it just redirected them in greater concentrations. The project team decided to seal off the incoming air streams and record the results.

There were much better results when the incoming air streams were also closed off as much as practicable. These air streams need not be from a controlled air intake. Removing all controlled air intake resulted in no change to the dust levels or efficiency of the extraction system. The system drew the air in from other sources such as normal openings and gaps.

Encapsulating the saws, heads etc proved the most effective way to reduce the airborne particles. It was also found that deflecting the streams of polluted air would allow the dust to fall into the extraction zone.

Deflecting the stream can be as simple as placing a piece of timber in the path of the air stream allowing the by-products to fall directly into the mouth of the extraction system as displayed in Figures 4 and 5. One project undertaken in Northern Sweden using this strategy resulted in airborne particles being reduced by up to 80 percent.

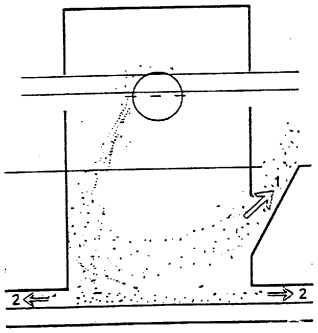


Figure 4.

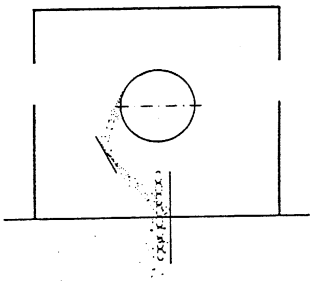


Figure 5.

In 1996 Tratek also completed a project based on the principles of process ventilation.

This concept for dust extraction technology is aimed at minimising both the dust emission from the machine and the use of energy. The most important part of the new concept is the dust extraction hood. Instead of designing it to accept as many tools of different types as possible, it is designed to fit one specific or a few similar tools.

Rather than trying to overcome the natural air current generated by the tool with the dust extraction airflow, which had been the traditional procedure, the new hoods are designed to fit very closely around the tools. In this way the natural air current around the tool can be restricted and used where it is advantageous.

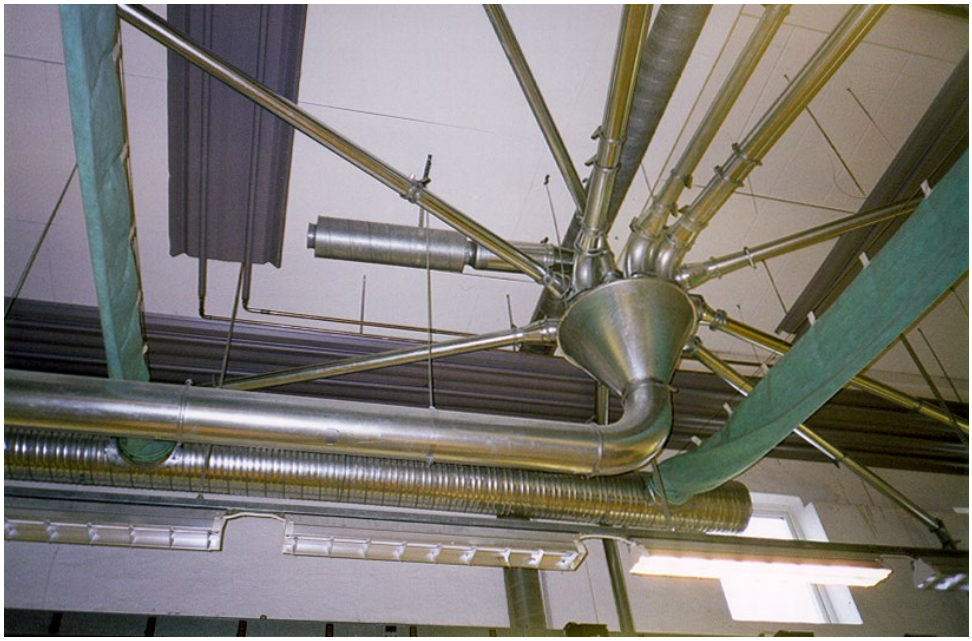
By carefully designing the dimensions and the direction in which the air pollutants leave the tool, combined with some simple aerodynamic principles, the hood can in many cases be so designed, that the stream of refuse and dust is delivered into the extraction system with no or very little help from the dust extraction airflow.

With this new concept for hoods, there is no need to dimension the velocity and flow of dust extraction air to overcome the natural tool airstream. It can be dimensioned for the main task of transporting the dust and chips through the ducts, which requires much less flow and velocity than the conventional systems perform.

These types of hood are far more efficient by the way of dust control than the traditional design and require much less dust extraction airflow. Since the dust extraction fans can be large consumers of electrical energy, a reduction in airflow may also contribute substantially to energy saving. Savings of up to 65 - 70 percent have been recorded where equipment utilising the new concept has been installed.

If the hoods are used in combination with a dust extraction system which allows an airflow to the hood only when the tool is at work, the electrical energy consumption for the dust extraction fan can be reduced by as much as 85 to 90 percent.

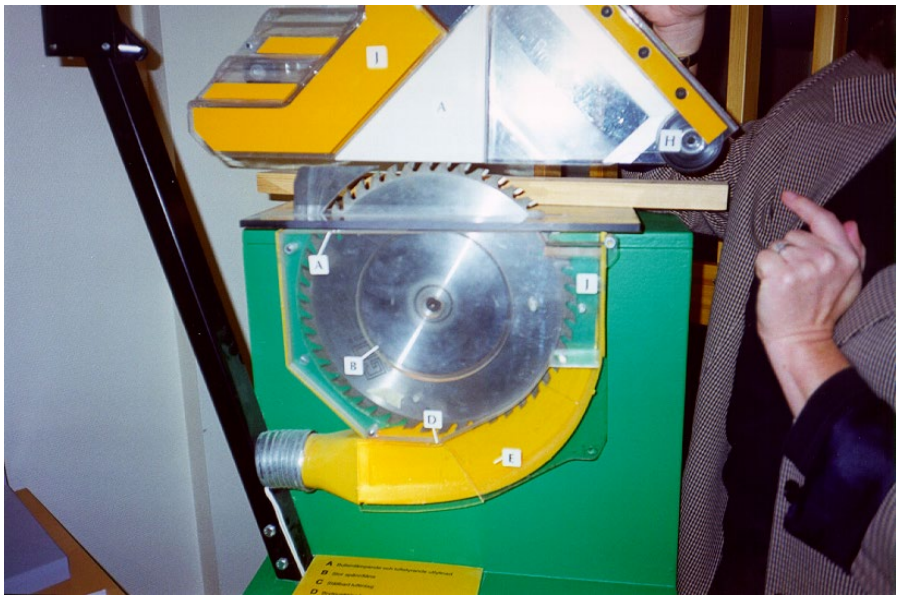
Traditional dust extraction systems use high air speed, regardless of the actual requirements. An alternative approach is to have all the extraction lines coming together at one central point and then entering the main extraction line. A system such as this means that lower fan speeds can be used to obtain the same end result. Systems such as these that use smaller, more efficient motors can save energy and reduce noise levels.



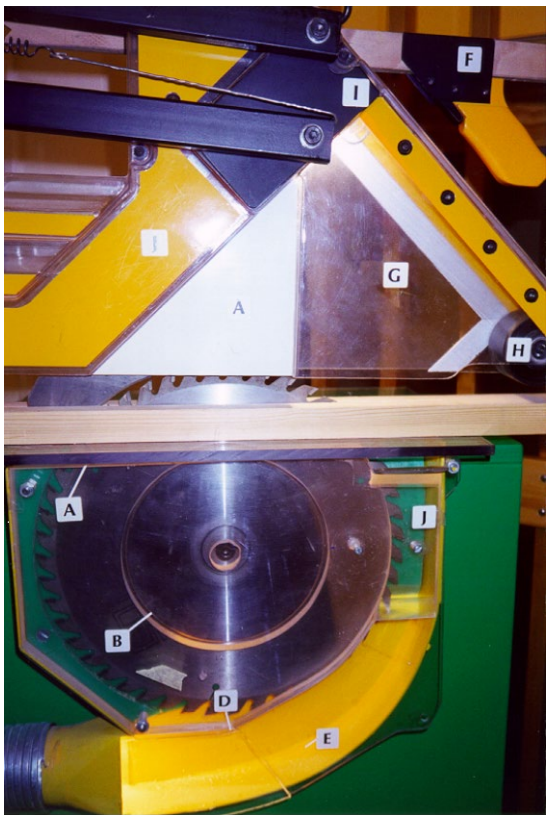
Central line extraction system

It must, however, be pointed out, that such a system requires careful planning and design. Installing and using shut-off valves at all extraction connections in a conventional system can cause serious problems with clogged-up main ducts etc. Alterations to existing systems must be considered carefully prior to any works.

Among the benefits of the new design are recorded reductions in the noise level, of up to 10 dB(A) in some instances.



streamlined extraction unit - Tratek Jonkoping, Sweden



circular saw extraction unit - Tratek Jonkoping, Sweden

extraction unit on sanding belt - Tratek Jonkoping, Sweden

Key points to consider when planning and utilising process ventilation in the workplace include the following.

- The quality of any solutions to problems are dependent upon the knowledge of the person designing the system. Gathering as much information as possible about equipment, layout, production requirements etc is essential at the planning stage. Often plans are created with an unspoken assumption that the building is possibly sealed and relatively draught-free. In reality this may not be the case and needs to be taken into account.

- Knowledge and experience of the operating and maintenance staff must be sufficient to properly operate and maintain the ventilation system. Additional education and training may be required.

- Because of the nature of sawmill design, the ventilation system may be influenced by the wind travelling through the building. This effect can be reduced where required if dividing walls or air barriers are installed.

- The better the encapsulation of the machine, the better the exhaust can catch the pollutants. It is not always suitable to place the exhaust point as close to the source of the pollutant as possible. This is because the speed of the polluted air is sometimes so great that the exhaust cannot catch it. An exhaust point should always be combined with a tight encapsulation and/or encasement of the machine.

- There must be properly designed exhausts connected to the process ventilation so that the pollutants are caught efficiently. The manufacturer should be able to provide recommendations on where the exhausts should be positioned and the appropriate airflows required.

- The shape of the exhaust points and the speed of suction have a deciding influence over whether the process ventilation works effectively or not.

- The duct system must not have sharp bends or cause sudden changes in the speed of the air.

- During planning ensure sufficient room is allowed for ducts, connections, spots for observation and cleaning and for the maintenance of ducts and other ventilation equipment.

Manufacturers of sawmilling and processing equipment within Sweden have been working together with industry in an attempt to combat some of the noise and dust problems associated with the use of their machines. Unfortunately, it appears that German component and equipment manufacturers have not been so enthusiastic about these issues.

A great deal of German manufactured processing equipment is used throughout the world and potentially lacks state-of-the-art control measures. Tratek and other OHS experts in Sweden are strongly of the opinion that pressure must be applied to these German manufacturers by purchasers if there are to be any improvements in standard control measures at the manufacturing stage.

Denmark

Many of the concepts utilised in Denmark for wood dust projects are similar to those being used in Sweden.

- Encapsulation and closing of incoming air streams around tools.
- Low impulse ventilation.
- Process ventilation and appropriate extraction systems.

Junkers Industries is a parquetry flooring producer located just outside Copenhagen. The company employs over 1,000 people in 12 production departments and uses mainly beech and oak for its products.

As part of a recent project some wood dust monitoring samples were carried out on one of the flooring sorting lines. Readings were taken at three (3) different operator positions where no ventilation was in existence. The readings were as follows:

Position 1: *24.0+mg/m^3*
Position 2: *24.0mg/m^3*
Position 3: *5.4mg/m^3*

By introducing appropriate extraction systems at the belts, encapsulating the conveyors where practicable and installing low impulse ventilation at the work stations (refer figure 2) wood dust levels were reduced to approximately 3.5mg/m^3 at all three (3) positions.

Whilst recordings of 3.5mg/m^3 are still over the national exposure standard, they are a definite improvement and have made a noticeable difference to the working environment.

Junkers Industries is continuing to work towards improving these figures further and meeting national exposure standards.

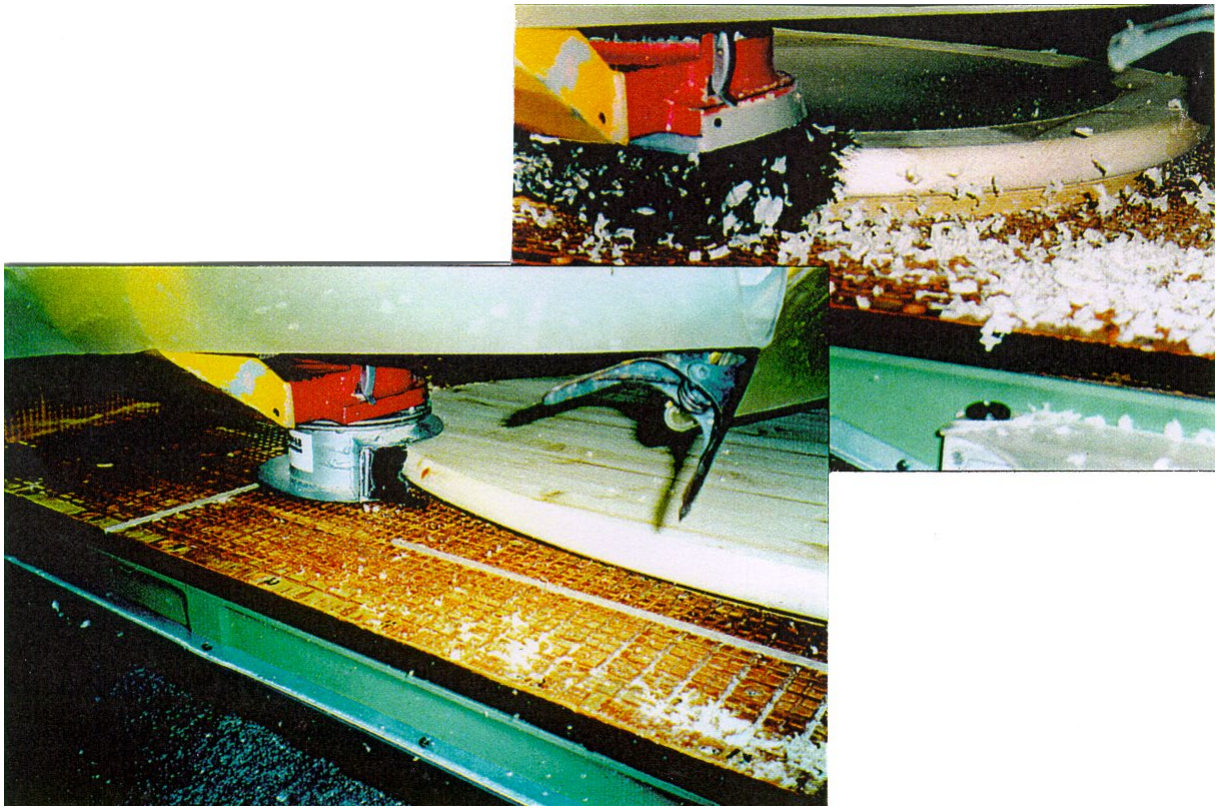
The DTI is also involved in developing solutions to some of the common problems experienced throughout the industry. The DTI firmly believes that any solutions presented to industry must be practical and cost effective, as well as improving productivity and/or energy consumption.

The DTI has been working on an issue associated with the use of CNC routers, of which there are about 1,000 in use in Denmark.

Cleaning brushes on the tool caused the problem. The extraction system was installed to function at 20m/s velocity during operation. Sampling identified that the velocity of the air was actually reduced to 5m/s at the product - where it was required. As a result the dust and by-product were not being effectively removed, clogging the brush and work area.

It was identified that too much air was 'escaping' from the opening where the brush sat, thus reducing the air flow considerably.

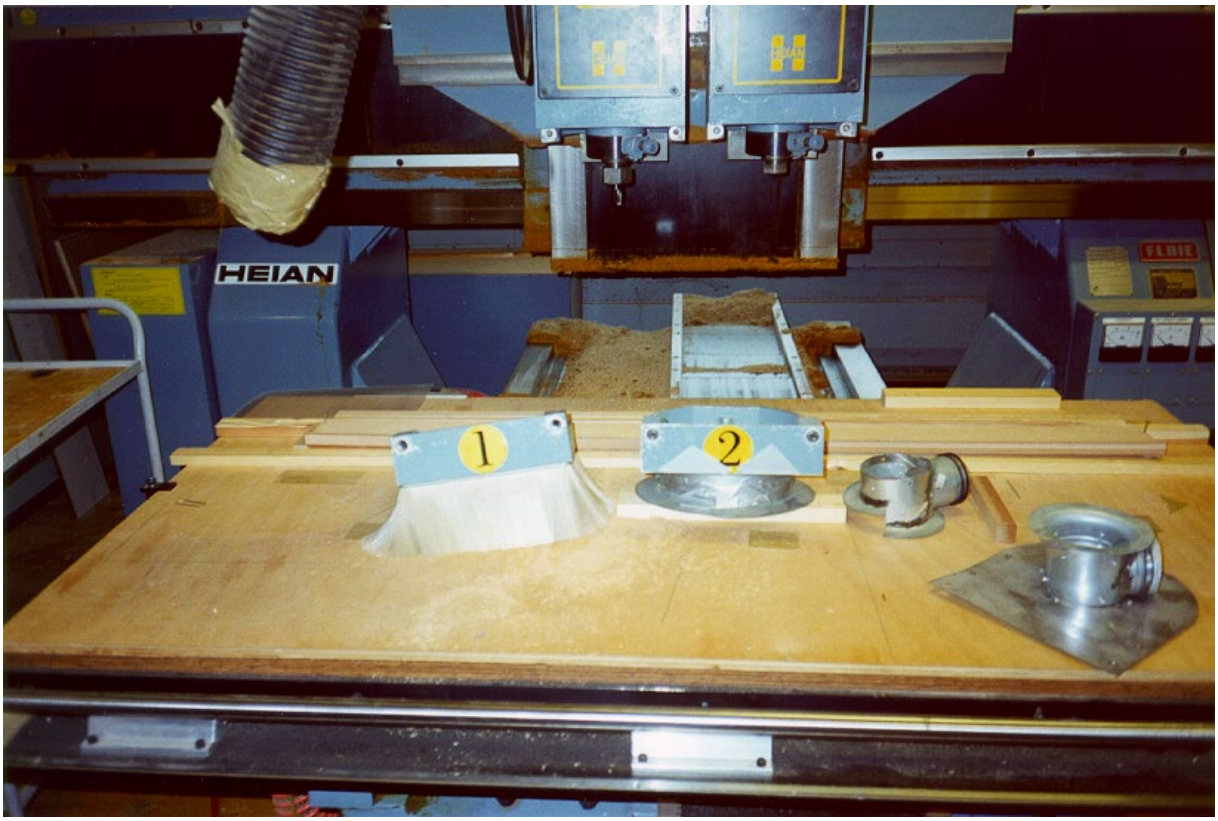
By enclosing the brush as much as possible and leaving only enough open space for it to fit over the product a vast improvement was immediately made. The controlled air velocity returned to 20m/s and proved more than adequate to efficiently remove all the dust and by-product from the timber and immediate work area. This solution was published for industry complete with clear, colour photographs (see below) to demonstrate it's effectiveness.



The DTI is also experimenting with different types and sizes of flanges to improve both air velocity and extraction ability on a variety of machines. Some of these are discussed in detail in a report completed by the DTI in March 1988, although at the time of the study tour it was not yet available in English.

Aigner also produces a catalogue of safety and working units that is written in English and available from its Asian or American distributors.

Industry recently funded a series of brochures detailing solutions to common problems and these have been widely distributed.



Various Flanges

Environmental issues appear to be particularly sensitive and the DTI is working with industry to produce environmental bulletins. These are done for individual companies and display information such as energy consumption, material use, waste disposal and environmental management. To date 30 of these bulletins have been prepared for organisations.

The Danish focus appears to be very much on 'clean' technology and an environmentally friendly approach.

11. Conclusion

It has been clearly demonstrated that exposure to hardwood dust - particularly in an occupational setting - can and does induce a variety of skin and respiratory problems. Although dermatitis and other skin conditions can be common health effects of handling timbers, of more concern are the respiratory effects known to be associated with wood dusts, particularly hardwoods. These respiratory problems include the following in varying degrees: asthma; alveolitis; rhinitis; bronchitis, airway disorders, irritations of the nose and eyes; wheezing and nasal itching. Prolonged exposure to hardwood dust can lead to mucostatis, which has been linked to the development of nasal and para-nasal cancers. Exposure to the volatile organic compounds found in softwoods – monoterpenes – can also lead to a variety of respiratory irritations.

Whilst many of these health effects, such as asthma, bronchitis and rhinitis are common and may not be associated with a person's occupation, cancer of nasal and para-nasal sinus is relatively rare and can nearly always be directly related to occupation. The incidence rate for such cancers have been recorded as 1 per 1 million people in the general population and 250 per 1 million for timber industry workers.

In 1995 the IARC classified wood dust as a Group 1 carcinogen to humans. This classification is a result of a marked increase in the occurrence of cancer of the nasal cavities and para-nasal sinuses among workers exposed to hardwood dust.

This study tour to Sweden, Denmark and the Netherlands has clearly shown that the management of wood dust in the workplace is a significant issue for the EU. Each is experiencing a period of change with regard to the exposure standards for wood dust and this affects regulatory authorities, employer groups and trade unions alike.

Employer groups seem to have taken the initiative with regard to finding ways to reduce the amount of air borne wood dust in workplaces. This work is, for the most part, being undertaken through research and development facilities with funding through industry contributions to the facility or particular project. These initiatives appear to be very successful in reducing the amounts of wood dust employees are exposed to.

Trade unions also demonstrated the importance of their role in the management of wood dust issues. Their focus is on employee education and training, but in many circumstances they have also been successful in applying political pressure to reduce exposure standards or achieve positive outcomes for their members.

One notable point that came through in each of the countries visited is that the regulatory authorities do not appear to have clearly defined management strategies to deal with these changes. The goal of the regulatory authorities should be to educate employers and employees to the degree that they understand and comply with exposure standards for wood dust. The success or failure of the regulatory authorities in achieving this outcome is dependent upon formulating and implementing appropriate management strategies. Even then they will not know if the strategies have been successful unless an evaluation project is undertaken to measure exposures in workplaces. This is unlikely to happen in the immediate future because of the skills, equipment and time required to undertake such a project.

There are many commonalities between the timber industry in Europe and that in Australia and they are facing the same or similar OHS issues to those in Australia. This author believes that Australia can gain a great deal of knowledge from the work currently taking place in Europe and from that which is planned for the future. This is particularly true for issues such as reductions in the accident rate, noise management and manual handling, as well as wood dust.

Seven recommendations follow this report. The primary focus of the recommendations is to increase Australian industry's level of knowledge concerning wood dust, it's health effects and ways in which it can be managed in the workplace.

The current level of activity in the European community concerning wood dust sends a strong message that this issue cannot be disregarded by any country which processes and/or manufactures timber products. Wood dust, together with other OHS information, must be incorporated into leadership strategies of the future for the timber industry.

12. Recommendations

The primary purpose of the following recommendations is to increase industry's level of knowledge concerning wood dust, it's health effects and ways in which it can be managed in the workplace.

Recommendation 1

A national timber industry occupational health and safety committee be formed to:

- address issues on a national basis;
- share information between states;
- obtain national consistency regarding health and safety issues such as wood dust;
- set agendas and develop leadership strategies for forest industries;
- foster OH&S contacts at an international level.

Such a committee should have representation from each state and territory involved in the timber industry.

Recommendation 2

A national training and education program be developed for employers and employees. Such a program should address both exposure standards and the health effects associated with hardwood dust exposure. This program could be delivered through state based employer groups or other suitable contacts.

Recommendation 3

A pilot program be devised and implemented to monitor and survey a broad cross-section of industry employees to:

- establish the levels of hardwood dust workers are currently being exposed to; and
- identify the health effects that workers may be experiencing due to occupational exposure to hardwood dust.

This will allow targeted management strategies to be developed and implemented.

Recommendation 4

Material Safety Data Sheets (as drafted by the National Association of Forest Industries in 1994) be reviewed and updated. Material Safety Data Sheets normally have a five (5) year life to ensure they are current and contain all relevant knowledge. Ideally this would be undertaken by a national OHS committee, or through the National Hardwood Forum.

Recommendation 5

A literature review and further work be carried out specifically on the issue of monoterpene exposure from softwoods. Softwood processing comprises a substantial proportion of Australia's timber industry and monoturpene exposure is an issue that is gaining importance in Europe. A number of countries already have exposure limits and are currently undertaking research on this subject. Australia should take the opportunity to tap into this ongoing research as early as possible.

Recommendation 6

A model purchasing specification be created outlining minimum safety requirements for new equipment. Such a specification has broader application and could encompass noise levels, machine guarding and brakes as well as other OHS issues.

Recommendation 7

In conjunction with education and monitoring programs it would be useful to explore the feasibility of a long term health monitoring program for the timber industry. This would provide an opportunity to monitor the health of employees currently working in the industry and develop accurate profiles on the incidence of health effects associated with exposure to wood dust in Australia.

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Appendix 1

Professional Contact List

Netherlands

Company Name	Contact	Address
ARBOTECH	Wim Tiessink Director	Postbus 722 8000 AS Zwolle
Vereniging Van Nederlandse Houtondernemingen	Frans de Boer C.E.O.	Postbus 1380 1300 BJ Almere
Ministry of Social Affairs	Denes Olivier International Exchange Gerard van der Wal Senior Inspector	Postbus 90801 2509 LV den Haag d.j.olivier@minszw.nl
Houthandel Vries	G Vries Director Martin van der Klok Production Manager	Postbus 9435 9703 LP Groningen Info@houthandelvries.nl

Sweden

Company Name	Contact	Address
ARBIO	Staffan Aminoff OHS Manager	Box 16006 103 21 Stockholm
Soderqvist Consulting	Anders Soderqvist Project Coordinator	Slattervagen 1 135 42 Tyreso anders.soderqvist@swipnet.se
Tratek ***Swedish Institute for Wood Technology Research***	Kaj Lindblad Manager Mai Isakson Research Engineer	Asenvagen 9 SE-553 31 Jonkoping Kaj.Lindblad@Tratek.se Mai.Isakson@Tratek.se
Tracentrum	Fredrik Ericsson Project Manager Paula Garback Project Manager	Framtidsvagen 1 Box 174 S-571 22 Nassjo fredrik.ericsson.tc@nassjo.se info.stc@mbox.swipnet.se
National Board of Occupational Safety And Health	Kerstin Wahlberg Occupational Hygiene	S-171 84 Solna kerstin.wahlberg@arbsky.se
OPUS akustik ab	Gunnar Eriksson Principal	Box 282 891 26 Ornskoldsvik ge@opusakustik.se

Denmark

Company Name	Contact	Address
Timber, Industry & Construction Workers Union (TIB)	Jorgen Mulbjerg Group Chairman Lennart Sorensen OHS Officer Kjeld Sorensen OHS Officer	Mimersgade 41 DK-2200 Copenhagen N
Confederation of Danish Industries	Henning Fokdal Head of Department	DK-1787 Copenhagen V di@di.dk
BST - Koge	Tommy Christiansen OHS Technician Annegrete Snogdahl Physiotherapist	Sondre Alle 43B 4600 Koge
Junckers Industries	Kim Bohmert OHS Chief	Vaerftsvej DK-4600 Koge

Danish Technological Institute - Centre for Wood Technology	Knud Erik Kvist Head of Section Elmer Svendsen Consultant	Gregersensvej P O Box 141 DK-2630 Taastrup Denmark Knud.Erik.Kvist@dti.dk Elmer.Svendsen@dti.dk
Danish Working Environment Service	Peter Herskind Head of Department Jane Marianne Ravn Frank Sorensen Field Officer	Landskronagade 33 DK-2100 Copenhagen jmr@dir.arbejdstilsynet.dk Holbaekvej 106B DK-4000 Roskilde FRS@rosk.arbejdstilsynet.dk
BAT Kartellet (Union Service Provider)	Ulrik Spannow OHS Officer Gunde Odgaard	Kampmannsgade 4 Post Box 392 DK-1790 Copenhagen ulrik.spannow@sid.dk

Appendix 2

Findings of Exposure Monitoring

Author	Sample Population (Personal Monitoring)	Finding
Department of Occupational Health, Safety and Welfare (WA)	15	11 exceeded 1mg/m^3
Kilpatrick & Associates Pty Ltd (Report 1)	15	1 exceeded 1mg/m^3
Kilpatrick & Associates Pty Ltd (Report 2)	15	12 exceeded 1mg/m^3
Hounam & Williams	58	mean of 7.5mg/m^3
Scheeper, Kromhout and Boleij	23 36	mean of 5.0mg/m^3 mean of 4.7mg/m^3
Pisaniello, Connell and Muriale	68	mean of 3.8mg/m^3

Appendix 3

WOOD DUST
Existing regulations I the different member countries

Country	Existing Installations	New Installations
Austria	5mg/m^3	2mg/m^3
Belgium	3mg/m^3	
Denmark	2mg/m^3	
Finland	5mg/m^3	
France	3mg/m^3 (1mg/m^3 forseen '97) - inhalable fraction only	
Germany	5mg/m^3	2mg/m^3
Greece	5mg/m^3 (respirable dust), 10mg/m^3 (total dust)	
Italy	10mg/m^3 (STEL)	
Netherlands	2mg/m^3	
Norway	2mg/m^3 (Nordic species, except oak & beech) 1mg/m^3 (exotic hardwoods, oak & beech)	
Poland	2mg/m^3 (hardwood dusts, oak & beech) 2mg/m^3 (mixed wood dusts, containing oak & beech) 4mg/m^3 (other wood dusts)	
Portugal	10mg/m^3 (total particulate dust) 5mg/m^3 (respirable particulate dust)	
Spain	10mg/m^3	
Sweden	2mg/m^3	1mg/m^3
United Kingdom	5mg/m^3	

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