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**Summary report
Occupational Hygiene
implications of recycling wood**

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EXECUTIVE SUMMARY

Objectives

To assess the health risks associated with recycling waste wood into wood chip.

Main Findings

Waste wood of mixed type and origin was recycled at all sites in broadly the same way. The waste wood was loaded into a primary chipping machine and then subjected to a screening process that produced chipped wood of the required grade and fine material. All the sites used mobile chipping and screening machines. Wood, chipped wood and fines were generally moved around site using shovel loaders and/or 360-degree loaders. The uses of chipped wood and fines include animal bedding, 'renewable' fuel, manufacture of chip /fibreboard and landscaping products.

The process of chipping and grading of waste wood generates substantial amounts of airborne wood dust, which can lead to exposures in excess of the workplace exposure limit (WEL) if adequate control measures are not in place.

Eight-hour time weighted average exposures (8-hr TWA) ranged from 0.29 to 52.4 mg/m³. Of the fifteen 8-hr TWA exposures measured seven exceeded the WEL of 5 mg/m³.

Due to the high levels of dust generated, machinery used for chipping wood gets heavily contaminated and requires thoroughly cleaning at the end of each shift. Cleaning is often performed using compressed air and manual sweeping methods that generate high levels of airborne dust. The duration of cleaning activities monitored were between 32 and 195 minutes, task based exposures for these activities ranged from 0.23 – 150 mg/m³.

Large quantities of waste wood and product were processed and stored, usually in the open air, in a relatively dry state. Various methods of water mist suppression were employed at all the sites visited; however its effectiveness was variable. Exposures were generally lower where mist suppression had been fitted to the chipping and screening machinery rather than where it was just applied to the waste wood and/or recycled products.

Significant deficiencies were found in the risk assessment (COSHH assessment) of exposure to wood dust, and in the management of exposure control at all of the sites visited.

1 INTRODUCTION

The aim of the work covered by this report was to visit a small number of sites to assess the extent of the health risks posed by exposure to inhalable wood dust and other chemicals present as a contaminant during the recycling of waste wood into wood chip. The findings will subsequently be used to determine whether further HSE intervention in this industry is necessary.

Research revealed that there was a scarcity of historical exposure data for this industry. The limited data that was found indicated that there is potential for very high exposure to wood dust.

1.1 HEALTH EFFECTS

Both hardwood and softwood dust have a Workplace Exposure Limit (WEL) of 5 mg/m³ 8 hr time weighted average (TWA). They also both have a “sen” notification indicating they are capable of causing occupational asthma. In some cases skin contact with certain wood dusts can cause allergic or contact dermatitis. In addition, hardwood dust has a “carc” notification, indicating it is capable of causing cancer. The International Agency for Research on Cancer (IARC) has classified wood dust as category 1 (carcinogenic to humans) carcinogen, and makes no distinction between hard and soft woods.

Given the health effects associated with wood dust, employers have duties under the COSHH regulations to prevent exposure. Where that is not possible there is a requirement to reduce exposure to all wood dust as far below the WEL as is reasonably practicable

1.2 PROCESS DESCRIPTION



Photograph 1. Pile of mixed waste wood

All the sites visited operated in a very similar way. Waste wood from a variety of sources is delivered to site by lorry and mostly stored outdoors. This wood is then loaded into a chipping machine using a mechanical shovel or grabber. Chipping machines are mobile units which can be used both inside and outside of buildings.



Photograph 2. Shovel loader moving waste wood.



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Photograph 3. Wood chipping machine.

After chipping, the wood passes through a magnet to remove metallic items prior to entering a screening process. On some sites the chipped wood was transferred directly to the screening machines, whereas on others a mechanical shovel loader was used to transfer it. The screening process grades the chipped wood and separates out the fine material. The chipped wood and fines are either transferred to lorry or boat for transportation to other companies, or as in one case the fines are stored on site.



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Photograph 4. Showing coarse wood chip.

Regular cleaning and maintenance of machinery and vehicles is essential and was usually carried out at the end of each shift by process operatives. Typically this took between 30 and 90 minutes. However at one site the chipping machine was being cleaned in preparation for transportation, here the cleaning took approximately three hours. Tasks include, cleaning out engine bays, cleaning the outside of machinery, blowing out air filters for engines and refuelling the machinery. The use of compressed air and dry sweeping techniques was normal for the sites visited. An instruction panel attached to a machine used at one of the sites had a graphic that appeared to recommend cleaning the engine compartment with compressed air. The site that performed the thorough three hour clean used water hoses to clean down the outside of the machinery.

Uses of wood chip and fines produced by the chipping process include the manufacture of chipboard, fibreboard, medium density fibreboard (MDF), animal and poultry bedding and landscaping products. Another recent significant market for wood chip is as a renewable fuel for energy production.



Copyrighted to Tracey Timber Recycling

Picture 5. Wood chip on horse gallops.



Copyrighted to Norbord

Photograph 6. Board made from recycled wood.

2 FIELD WORK

Four survey visits have been included in this report to sites where wood was chipped and graded prior to being transported to a third party. At each site an assessment of inhalation exposures to wood dust and background levels of airborne wood dust were made during wood chipping and screening. Personal air samples were taken during typical work activities and static samples taken adjacent to the processes. Where possible, the end of shift clean down of machinery was monitored as a separate, discrete task.

Personal and static air samples for inhalable dust were taken as per HSE Guidance MDHS14/3 "General methods for sampling and gravimetric analysis of respirable and inhalable dust" using glass fibre (GFA) filters mounted in IOM sampling heads, aspirated at 2 litres/minute. Samples were analysed for inhalable dust using gravimetric techniques.

Due to the relatively low numbers of workers exposed to wood dust at the sites visited personal samples were placed on all those who were involved in the wood recycling process.

At two of the sites visited the presence of Volatile Organic Compounds (VOC's) and toxic metals was investigated in the more heavily-loaded atmospheric dust samples. Analysis of a selection of filters for the presence of metals was done using an Energy Dispersive X-ray Fluorescence (EDXRF) technique. In addition to this analysis of a selection of wood fragments and filters for presence of volatile organic compounds (VOC) was done by direct thermal desorption at 100°C and capillary gas chromatography with mass selective detection.

All sample analyses were carried out by the Health and Safety Laboratory.

Working practices, exposure controls, risk assessments, health surveillance programmes, and hygiene facilities were assessed on each visit.

3 FINDINGS

3.1 MEASURED EXPOSURES

Table 1: Summary of air sampling results by site.

Site ID	Site	Wood Dust	
		Personal Results 8 hr TWA (mg/m ³)	Static Results (mg/m ³)
1	Indoor and outdoor operations, plant cleaning not included.	0.43 - 0.94*	<LOD - 0.79
2	Outdoors only, included plant cleaning.	0.29 - 3.05	0.16 - 0.88
3	Outdoors only, included plant cleaning. Three results over 5 mg/m ³	0.39 - 52.36	0.17 - 8.18
4	** Outdoors only, included plant cleaning. Four results over 5 mg/m ³	0.9 - 15.3	0.1 - 29.1

*Cleaning activity was not monitored at this site therefore these results do not represent 8-hour TWA exposures.

** The results from this site were from samples taken in wet weather conditions.

Table 2: Summary of air sampling results by task.

Task Description	Task Result (mg/m ³)
Weighbridge operator	1.6
Pallet mending	0.92
Driving shovel/360 loaders with enclosed cabs	0.26 - 2.01
Fork lift truck drivers	1.69-3.47
Ground workers (These workers were involved in some cleaning work during a breakdown where compressed air was used. Breakdowns were reported as commonplace.)	13.28 & 18.47
Cleaning	0.23 – 150

A total of twenty seven exposures to wood dust were measured with results from 0.23 to 150 mg/m³, over sampling periods ranging from 32 to 400 minutes. Sampling was conducted during periods representative of typical production and for specific cleaning tasks. 8-hr TWA exposures were calculated taking account of, where appropriate, task based measurements and using shift patterns. In total fifteen 8-hr TWA exposures were calculated which yielded results from 0.29 to 52.4 mg/m³. Of the fifteen 8-hr TWA exposures measured seven exceeded 5 mg/m³.

The results from nineteen static samples indicated background concentrations of wood dust in air ranging from <0.1 to 29.1 mg/m³.

No significant levels of VOC's or toxic metals were found in the samples where these were measured.

3.2 FACTORS INFLUENCING EXPOSURE

3.2.1 Management controls

Three of the sites visited did not have any COSHH assessments available for inspection. The remaining site did produce an assessment but this was not deemed suitable and sufficient as it concentrated mainly on the physical dangers associated with the process as opposed to the dangers of being exposed to wood dust.

3.2.2 Local Exhaust Ventilation (LEV)

None of the sites visited used local exhaust ventilation as a control measure to reduce operator exposure.

3.2.3 General Ventilation

With the exception of one site, that performed half of its work indoors, wood chipping and screening took place outside and was therefore subject to external weather conditions. No forced general ventilation was in place at the site where wood chipping was carried out indoors.

3.2.4 Other controls

All the sites visited used water suppression to help minimise the amount of dust generated. Two of the sites (Site 3 & Site 4) applied water to the material after it had been chipped, one had applied it to the chipping and screening machines (Site 1) and the final site (Site 2) wetted the wood prior to chipping, employed a perimeter dust suppression system and applied mist suppression to the chipping process.

Most of mechanical shovels and loaders used on the sites had enclosed cabs fitted with air conditioning that included filters of some type. The efficiency of the cab filtration systems was not investigated in detail. However, the air monitoring results indicate that these worked effectively.

3.2.5 Personal Protective Equipment (PPE)

Wearing high visibility clothing and safety boots was mandatory on all of the sites visited, with three of the sites including head protection as mandatory. At all the sites operators wore their own or company supplied casual clothing that was laundered at home. Two sites supplied eye protection and hearing protection.

Respiratory protective equipment (RPE) was supplied on three out of the four sites. This RPE ranged from P1 disposable respirators to orinasael respirators fitted with P3 filters. At all the sites where RPE was supplied there didn't appear to be any clear policy on when RPE should be worn, no provision of training and no face fit testing of users. On day of visit ground workers at Site 3 wore negative pressure half mask respirators for the entire working shift.

3.2.6 Health Surveillance

The use of health surveillance was not reported at any of the sites visited.

4 DISCUSSION

Working methods at all the sites visited were broadly the same. Mixed waste wood was delivered to site by lorry, tipped out and then loaded into a chipping machine, the shredded material was then passed through a screening machine that separated wood chip from fine material. In some cases the chipping machine and screening machine were located side by side, in others shovel loaders were used to transfer shredded material to the screener. Screened wood chip and fines were then transferred to lorry, boat or storage, again using shovel loaders. The process was operated by a combination of vehicle drivers and ground workers, who worked adjacent to the chipping machinery.

Measured 8hr TWA exposures to wood dust exceeded the WEL for seven of the fifteen exposures measured. It was not possible to report 8hr TWA's for Site 1 because the sampling periods did not cover cleaning and maintenance activities. Information on cleaning was not collected but based on information from the other sites visited it is likely that cleaning would have been carried out on a daily basis.

Task based results indicate that the higher exposures measured are attributable to operators who were 'ground workers', drivers of machines without air-conditioned cabs and in particular the end of day cleaning activities. The use of compressed airlines to clean down machinery was the common method used and resulted in excessive exposure to wood dust.

Workers who drove air-conditioned vehicles or who worked on tasks remote from the main chipping and screening areas typically had lower exposures.

Measures to control exposure involved the use of cab filtration, RPE and water suppression.

Air-conditioned cabs provided good exposure control for the employees who drive them. The filtration systems fitted should be subject to regular maintenance to ensure a good level of exposure protection is maintained.

Water suppression systems employed included on machine systems and manual wetting of product and/or waste wood. Observation and measurements suggest that none of the water suppression methods used fully controlled the generation of airborne dust. Given the large quantities of material processed at these sites it is unlikely that it could ever be sufficiently wetted to prevent dust generation. However the exposure results from sites where water mist suppression was applied to the wood chipping and screening machinery were generally lower.

RPE was not mandatory at any of the sites visited but was widely issued and used for cleaning tasks. The fact that none of the sites where RPE was issued had an RPE usage policy, any training or supervision, and had not carried out face fit testing indicates that RPE use would not have provided adequate exposure control.

The process of loading both waste wood into the chipping machine, and product into vehicles for transportation generates large visible dust clouds. This generally does not pose a high exposure risk as the operators are remote from these operations or inside vehicle cabs fitted with filtration.

Analysis of air samples and bulk samples from two sites for the presence of toxic metals and VOC's indicated that these do not present significant exposure risk.

At Site 3 there was sawdust bailing plant which packaged sawdust brought in from saw mills for sale as pet bedding. Although not monitored it was noted that the process was carried out indoors and produced very high levels of airborne dust.

Site 4 had a hand picking gantry installed on site that was not in use during the site visit. It was reported by the company that it was used occasionally when chipped wood contained a high level of contamination.

Other safety concerns noted during the site visits included working at heights during cleaning without adequate protection and blowing down machinery without eye protection. Where wood is processed or stored indoors there is potentially a risk of explosion should sufficient quantities dust become airborne.

The Health and Safety Executive had received complaints about excessive dust levels from neighbours of two of the sites visited. From observations made during this work this is likely to be repeated wherever this type of wood recycling activity is carried out outdoors, unless dust can be suppressed at source or the activity carried out at sufficiently remote locations.

5 CONCLUSIONS

Wood chipping and screening has the potential to create large amounts of airborne dust, which presents a significant health risk if exposures are not adequately controlled. There is also the risk of this dust contaminating other sites in the immediate vicinity. The spread of dust will be significantly worse in dry conditions. Findings from the sites visited indicate that exposures above the wood dust WEL are commonplace.

Exposure to machine drivers can be adequately controlled if vehicles are fitted with well maintained air-conditioned cabs.

The use of water mist suppression systems fitted to the chipping and screening machinery appeared to reduce the level of exposure of the operatives. However, this has little effect on exposures during cleaning down.

Because of the high levels of dust generated by the wood chipping process the vehicles and machinery used becomes highly contaminated and require regular cleaning (end of each shift). Without this, the diesel engines that power this equipment would rapidly become inoperable. Results and observations show that there is potential for extremely high exposure during this routine cleaning and maintenance of machinery.

The cleaning down of machinery and equipment is essential for it to operate reliably. All sites visited used compressed airlines during cleaning which created a high dust exposure risk to operators carrying out these tasks. Other cleaning techniques, such as vacuuming or wet cleaning, may offer a less dusty method. Where there is no alternative to compressed air blowing RPE is probably the only practical control option given the nature and duration of the work. Any RPE use should be backed up by a good RPE policy, user training, face fitting if required and adequate supervision.

At all of the sites visited there were significant deficiencies in the risk assessment (COSHH assessments) of employee exposure to wood dust, in the training given to employees and in the management of any controls that had been implemented.

No health surveillance schemes for occupational asthma had been implemented at any of the sites visited.