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Dust and noise levels in a teaching podiatry laboratory

Sue Reed

Sue Cusbert

Melanie Reed

Verona du Toit

DUST AND NOISE LEVELS IN A TEACHING PODIATRY LABORATORY

Sue Reed[1,2,3], *Sue Cusbert*[2], *Melanie Reed*[3] and *Verona du Toit*[2]
[1.]Edith Cowan University; [2.]University of Western Sydney; [3.]Reed OHE Pty Ltd

KEYWORDS

Podiatry, dust, noise, ventilation control

ABSTRACT

The use of Podiatry services is increasing and the exposure to dust and noise in Podiatry facilities has not been well documented in the literature. Concern for exposure to dust and noise has been raised due to the amount of particles seen when grinding and sanding custom moulded shoe inserts. Shoe inserts are made from a range of materials including polypropylene, polyurethane foams, ethylene/acetate copolymers, vinyl acetate and aluminina trihydrate.

Monitoring for $PM_{2.5}$, PM_{10} and noise was undertaken in a teaching podiatry laboratory on two days to ascertain if they were at a level hazardous to health. In addition the ventilation system was assessed to determine if the capture velocities were sufficient to determine if the current ventilation system is sufficient to control the potential hazards. Because the laboratory is used by a variety of students during the day, static monitoring was undertaken in preference to personal sampling so that a broad range of exposures could be determined.

The results of the dust monitoring shows that the levels of $PM_{2.5}$ and PM_{10} were within levels considered adequate from a public health viewpoint although peaks did occur during the clean-up of the laboratory.

Noise monitoring highlighted that although the average levels were acceptable there is concern that a number of machines have noise levels exceeding 80 dBA. The ventilation system was assessed from a qualitative (smoke tubes) and quantitative (velocity measurements) viewpoint, and because of the action of the spinning wheels and belt it was determined that they were not adequate.

INTRODUCTION

Concerns have been raised that there may be potential for people fabricating shoe inserts may be exposed to dust and noise levels which could have adverse health impacts. Monitoring for dust and noise was undertaken in a teaching podiatry laboratory for the fabrication of shoe inserts by grinding, sanding and polishing using a range of equipment as seen in Figures 1 and 2. The main aim of the assessment was to determine if the current ventilation system needs upgrading and if the students and staff using the laboratory need to wear respiratory and hearing protection. A review of the literature showed there were limited published assessments of podiatry laboratories and what has been published was in relation to bioaerosols when podiatrists were working on clients' feet.

Figure 1: Redwing Sander/Grinders

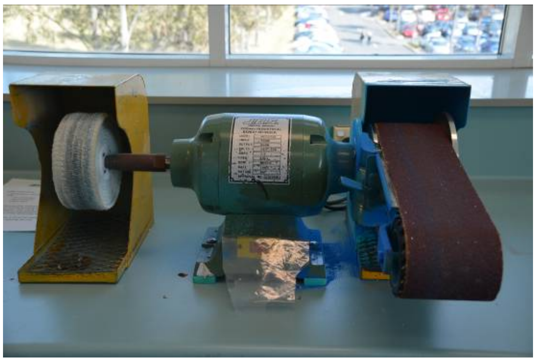


Figure 2: JBS Belt Sander and Buffer

Currently the Laboratory has the requirement that all people entering the laboratory are required to wear safety glasses, respiratory protection and hearing protection.

Monitoring was undertaken on two days. The first in May 2012, when a limited number of samples were collected, and then again in August, when all of the parameters were measured. The limits in monitoring were due to when the laboratory was in full use as it is restricted to the period of the teaching semester.

METHODS

Because the laboratory was used by a variety of students during the day static monitoring was undertaken in preference to personal sampling so that a broad range of exposures could be monitored. Sampling was undertaken between 10 am and 4 pm so that three separate laboratory sessions were monitored. A number of sets of monitors were located in the laboratory in the regions where the students were working. The parameters monitored included noise, a variety of dust size concentrations and the ventilation system to determine if it meets minimum requirements.

The products used in the laboratory were analysed from the information provided in the MSDS's provided by the product suppliers and held in the laboratory for review by people using the area.

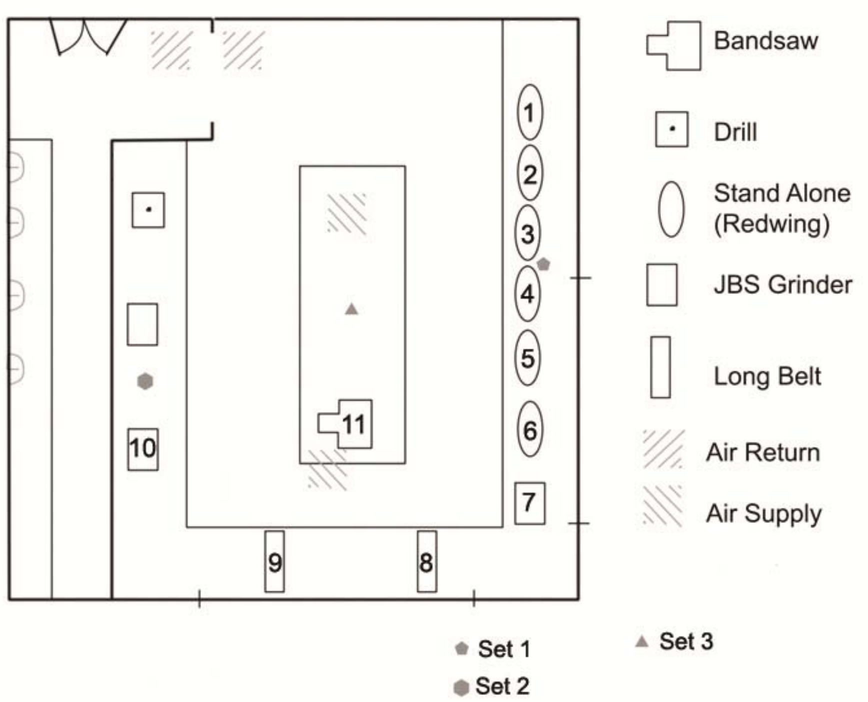
PM_{10} and $PM_{2.5}$ were monitored from a public health viewpoint as the health status of students using the laboratory is unknown and the results will be compared against the standards for ambient air which are designed for everyone. Monitoring was undertaken for PM_{10} using TSI DustTrak™ Model 8250 (Serial Nos. 23645 and 85201525) monitors and $PM_{2.5}$ using TSI Sidepak™ Personal Aerosol Monitor AM510 (Serial Nos. 10610094 and 10611057). Two sets of dust monitors were setup in the areas where the students were working, as indicated on Figure 3, and as close as possible to their breathing zone. Each set of monitors consisted of a TSI DustTrak™ Model 8250 measuring PM_{10} and a TSI Sidepak™ Personal Aerosol Monitor AM510 measuring $PM_{2.5}$. Monitoring was also undertaken in the centre of the laboratory for PM_1, $PM_{2.5}$, PM_4 (respirable), PM_{10} and total dust using a DustTrak™ DRX Aerosol Monitor 8533 (Serial No. 8533084003).

General workplace noise levels were measured using a Brüel and Kjær Sound Level Meter Model 2250 (Serial No. 2506131) using a ½ inch Brüel and Kjær Microphone Type 4189 (Serial No. 2543040) both of which comply with AS IEC 61672.1. Larson Davis Model 703 Dosimeters (Serial Nos: 20915 & 21918) and a Model 706 Dosimeter (Serial Nos: 20915) were also set up in conjunction with the air samplers to determine the variation in noise levels within the laboratory and determine if the noise levels are within acceptable levels as defined by the WHS Regulation 2011, Safe Work Australia (2012a) and AS/NZS1269:2005. Noise dosimeters were located at the same positions as the dust sampling equipment.

The ventilation system was assessed by using a Dräger smoke tube to determine the area of influence of the extraction systems. The face velocities for each of extraction slots and as well as the capture velocities and distances for each were assessed using a TSI Model 8345-M-GB (Serial Nos. 98110157) anemometer.

Figure 3: Layout of Podiatry Laboratory with Monitoring Positions Indicated

(Note: Numbers 1 to 10 relate to the sanding and grinding machines and measurement positions for noise and ventilation)



RESULTS AND DISCUSSION

Review of Chemical and Health Related Data Provided in MSDSs

An analysis of the current MDSDs in the laboratory showed that the majority were over 5 years old and did not meet the Australian guidelines for MSDSs published by Safe Work Australia either in the current format or the previous format. The two main chemical groups in the products used in this laboratory are Polypropylene and Urathane, and no exposure standards beenwere reported on the MSDSs for either of these products. The information available on other chemical constituents is very poor.

The main products ground, sanded and polished in the laboratory are:

- Alveolux – Orthotic Foam Material (sponge)
- Polypropylene
- Polystone P-ORTHO-NATURAL, homopolymer
- PORON XRD Urethanes
- Polyurethane Foam PPT (rolls and Sheeting)

The only product MSDS which included the exposure standard is the Ethylene/Vinyl acetate copolymer which has a exposure standard of 35 mg/m^3 TWA and 70 mg/m^3 STEL (Safe Work Australia, 2012b) for vinyl acetate in the vapour phase.

Dust Monitoring

The results of the dust monitoring for both days was undertaken over six hours which included two sessions, where a large number of students used the laboratory and a clean-up occurred at the end of each session. The time period covered was 10 am to 4pm.

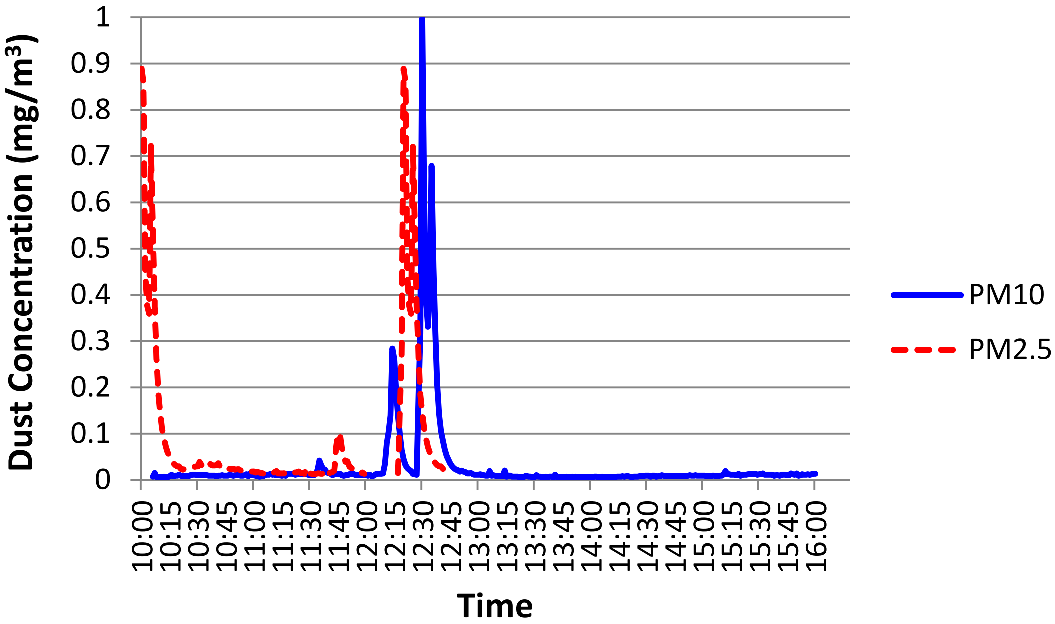
Table 1: Summary of Real-time Dust Monitoring

Location	Parameter Monitored	Date	Average	Minimum	Maximum
1. Between two Redwing Sanders on the window side of laboratory	$PM_{2.5}$ (mg/m^3)	8/5/12	0.011	0.003	0.194
	PM_{10} (mg/m^3)	8/5/12	0.012	0.004	0.241
	$PM_{2.5}$ (mg/m^3) #	28/8/12	0.070	0.012	0.889
	PM_{10} (mg/m^3)	28/8/12	0.028	0.006	0.998
2. Between two JBS Grinders on the wall side of laboratory	$PM_{2.5}$ (mg/m^3)	8/5/12	0.014	0.000	0.277
	PM_{10} (mg/m^3)	8/5/12	0.039	0.004	0.731
	$PM_{2.5}$ (mg/m^3)	28/8/12	0.039	0.006	1.48
	PM_{10} (mg/m^3)	28/8/12	0.025	0.006	1.711
3. In middle of room near band saw	PM_1(mg/m^3)	28/8/12	0.010	0.001	0.357
	$PM_{2.5}$ (mg/m^3)	28/8/12	0.012	0.001	0.711
	Resp (mg/m^3)	28/8/12	0.015	0.001	0.715
	PM_{10} (mg/m^3)	28/8/12	0.040	0.001	1.710
	Total Dust (mg/m^3)	28/8/12	0.114	0.001	7.280

sampler only ran for just over 2 hours as students turned the power off accidently to the instrument

When compared to standards for ambient air quality which have been developed to protect the general public the dust concentrations measured are not significant. The standards for ambient air quality are 0.050 mg/m^3 (50 µg/m^3) for PM_{10} and 0.025 mg/m^3 (25 µg/m^3) for $PM_{2.5}$ over 24 hours (*Department of the Environment and Heritage*, 2005). The results of the monitoring have not been compared to the occupational exposure standards because the particulate sizes monitored do not occupational exposure standard published by Safe Work Australia (2012).

Figure 2: Dust Concentration measured in the Breathing Zone of Students using the Redwing Sanders 3 and 4 on the window side of laboratory on 28 August 2012



The results of the instantaneous monitoring, shown in Figures 2, 3 and 4, show that although the standards are exceeded for a short time it is not very long. The average exposures are well below the recommended 24 hour standards as published by both WHO and *Department of the Environment and Heritage. It should be noted that if the respirable dust levels are averaged over 8 hours they are only 0.5 % of the respirable exposure dust standard of 3 mg/m^3 published by ACGIH (2012), the maximum measures at any time was less than 25 % of the exposure standard.*

The ambient air quality standards were used because the health status of students using the laboratory is unknown, the standards for the ambient air quality are significantly below what limited workplace exposure standards exist for the products being handled including ethylene/vinyl acetate (ES = 35 mg/m^3), calcium sulphate and urethane foam (ES = 10 mg/m^3).

An area of major concern is the current practice of dry sweeping in the laboratory to clean-up following the student work. This is the major source of the peaks in dust exposures as can be seen in Figures 2, 3 & 4 around 12:00. A similar peak is seen in Figure 4 just before 16:00. These peaks are the major source of the dust concentrations that in most cases are just above what are considered normal ambient dust concentrations.

Figure 3: Dust Concentration measured in the Breathing Zone of Students using the JBS Grinders on the inside wall side of laboratory on 28 August 2012

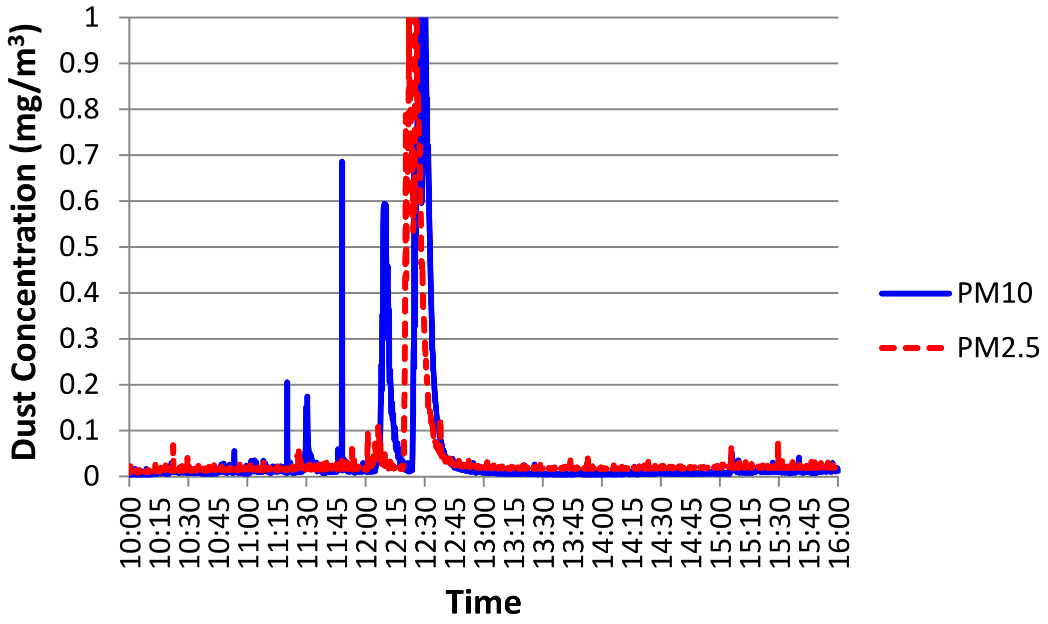
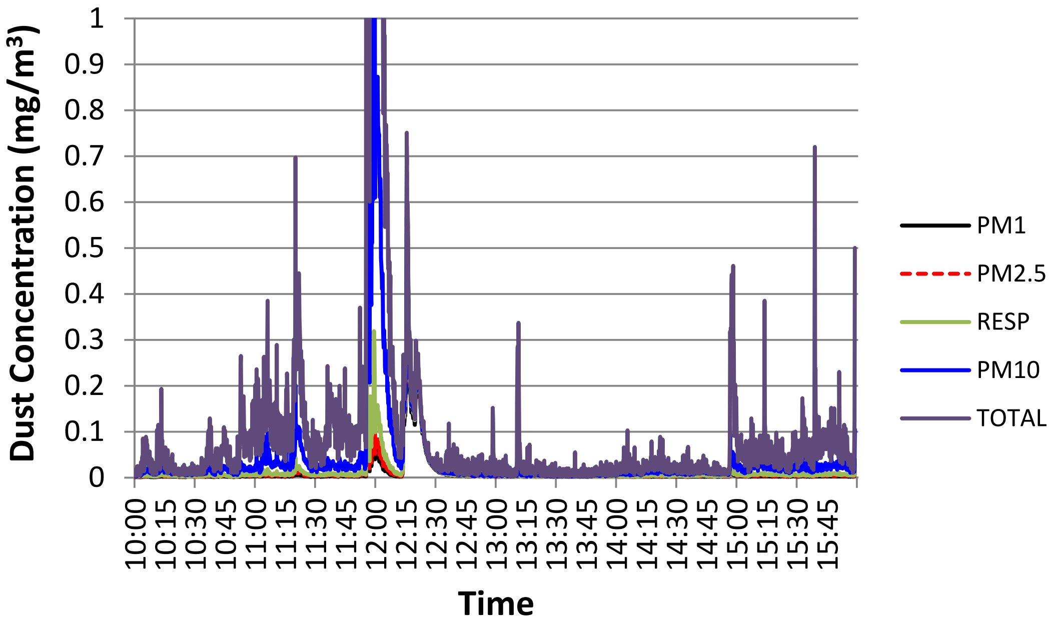


Figure 4: Dust Concentration measured in the Breathing Zone of Students near the Bandsaw in the middle of the laboratory on 28 August 2012



The results of the monitoring for dust shows that the current ventilation system is keeping the levels of inhalable and respirable dusts below that which is considered not hazardous to health, even though the extraction systems do not produce flow rates sufficient to capture particles generated with a velocity. Although large dust particles may be observed in the laboratory is it not at levels that are considered hazardous to health. The current compulsory requirement for the use of respiratory protection is not considered to be required, although students and staff may elect to wear dust masks for personal reasons.

Noise Monitoring

As with the dust monitoring the noise dosimeters ran over a six hour period from 10 am to 4pm and a summary of the noise dosimeter results is shown in Table2. Individual noise levels were measure at each workstation initially with all the machines running and then with only the machine being assessed running to determine which machines made the highest contribution to the noise levels in the laboratories.

Table 2: Noise monitoring of Individual machines in the Podiatry Laboratory

Location	All Machines Working		Individual Machines Working	
	L_{eq} (dBA)	Noise Peak (dBC)	L_{eq} (dBA)	Noise Peak (dBC)
1. Redwing Sander/Grinder	79.8	100.4	64.3	90.5
2. Redwing Sander/Grinder	80.6	100.4	66.8	92.0
3. Redwing Sander/Grinder	82.3	100.6	63.5	85.7
4. Redwing Sander/Grinder	82.8	98.9	68.9	93.3
5. Redwing Sander/Grinder	83.6	101.0	73.4	93.3
6. Redwing Sander/Grinder	85.5	105.1	65.0	88.1
7. JBS Long Belt & Polisher	89.7	104.3	91.0	104.4
8. JBS Long Belt &Buffer	87.8	104.1	87.8	104.4
9. JBS Long Belt & Buffer	85.9	102.8	82.7	100.1
10.JBS Long Belt & Grinder	88.4	104.2	88.4	102.7
11.Bandsaw	86.6	103.5	82.0	98.4

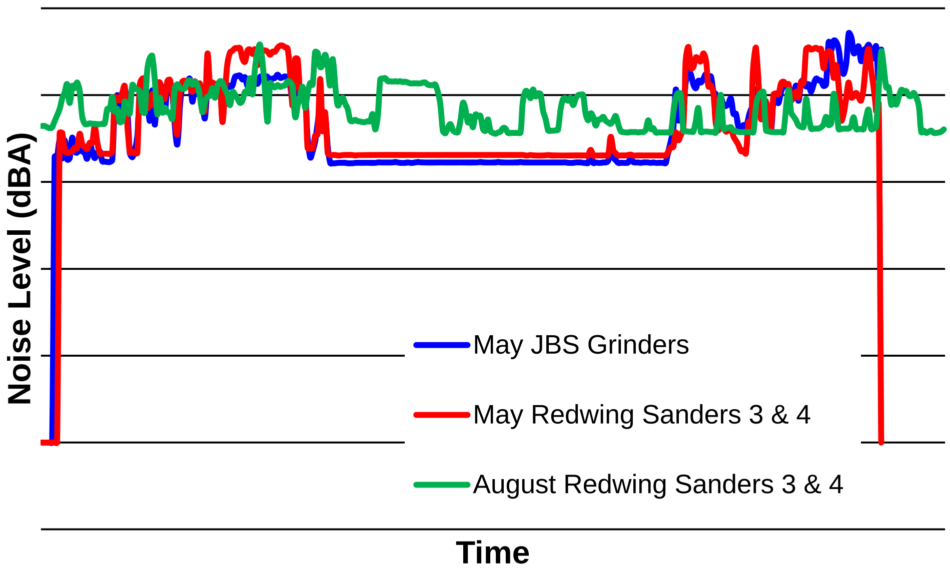
The results from the noise dosimeters logged over 6 hours are tabulated in Table 3.

Table 3: Summary of Real-time Noise Monitoring

Location	Date	Average L_{eq} (dBA)	Minimum (dBA)	Maximum (dBA)	Noise Peak (dBC)
1. Between two Redwing Sanders on the window side of laboratory	8/5/12	80.8	64.3	94.2	117.6
	28/8/12	78.3	64.3	98.5	121.4
2. Between two JBS Grinders on the wall side of laboratory	8/5/12	82.6	66.1	91.4	119.5
3. In middle of room near the band saw	28/8/12	78.8	65.2	99.6	125.4

The noise monitoring shows that noise exposures, although within the current limits, are dependent on the amount of time that the grinders and sanders are used on any one day. On the days of monitoring, (refer Figure 5), there was a two hour period when the sanding and grinding equipment were not used. When the grinders and sanders were in use the noise levels were typically over 85 dBA (refer Table 2). It should be noted that students and staff wore hearing protection when the sanders and grinders were in use.

Figure 5: Noise Levels measured in the Hearing Zone of Students using the JBS Grinders and the Redwing Sanders in the laboratory on 8 May and 28 August 2012



Based on the noise levels measured it would be good practice for the students and staff to wear a Class 2 hearing protector when either the sanders and/or the grinders are being used.

The current signs in the laboratory which relate to the wearing of dust masks and hearing protection need to be modified to indicate that hearing protection is required when the sanders and grinders are in use. The current signs indicate that both hearing protection and respiratory protection, in addition to safety glasses, are required at all times even when there is no inhalation or noise hazard present.

Ventilation Assessment

Initially the ventilation assessment involved using the Dräger tubes to look for the capture zones of each extraction system. Each of the Redwing Sander/Grinders only had dust bags attached to the extraction system as can be seen in Figure 4, where the Long Belt sander/Buffers and the JBS Grinders had an improvised extraction system attached to vacuum cleaners located in cupboards under the benches (Figure 6 & 7).

Figure 6: Effect of the Dust Extraction System for Redwing Sander/Grinders using Dräger Smoke Tube

Figure 2: Effect of the Dust Extraction System for JBS Belt Sander and Buffer using Dräger Smoke Tube

None of the ventilation systems worked adequately as can be seen in Figures 6 and 7 and if the capture distance was more than several centimetres from the extraction hood/slot the system collected limited smoke. The systems currently installed are affected by the spinning grinding wheel or belt which travels away from the extraction hood. They are also impacted on where on the wheel or belt the operator places the item to be grinded or sanded.

Table 4: Capture and Face Velocities at each Extraction Head

Location	Face Velocity m/s	Capture Velocity m/s
1. Redwing Sander/Grinder	1.78	0.14
2. Redwing Sander/Grinder	2.6	0.12
3. Redwing Sander/Grinder	1.4	0.13
4. Redwing Sander/Grinder	0.7	0.2
5. Redwing Sander/Grinder	2.0	0.17
6. Redwing Sander/Grinder	5.2	0.7
7. Polisher	4.1	0.23
7. Long Belt	3.85	0.41
8. JBS Long Belt &Buffer	0.7	1.04
9. JBS Long Belt & Buffer	6.65	0.76
10.Polisher	3.89	1.7
10.Long Belt	2.39	0.76

The face velocities and the capture velocities at each of the machines are indicated in Table 4, were measured at the face inlet (Face Velocity) to the extraction system and at the working position closest to the extraction inlet (Capture Velocity) which ranged from approximately 5 to 15 cm from inlet. Due to the particles being generated at a velocity it is recommended that the minimum capture velocity should be 0.25 to 1.0 m/s (ACGIH, 2010). Some of the capture velocities measured met the guideline of 1 m/s but only for machines 8 and 10 which were not commonly used.

CONCLUSION

The results of the monitoring on the 8 May and 28 August 2012 indicates that dust levels in the laboratory are within acceptable levels. However the current practice of using a broom to dry sweep the benches and floor should be replaced with a wet or vacuum system as it is the major source of the dust generation in the laboratory.

The noise monitoring highlighted that when some of the sanders and/or grinders were in operation the noise levels would exceed 80 dBA and in some areas 85 dBA. The majority of the noise was generated by the JBS belt sanders and wheel buffers which were at one end of the laboratory. These machines need to be replaced with quieter machines.

The assessment of the current ventilation systems that have been installed in the laboratory showed they are not adequate for collecting dust that is generated at speed. Consideration needs to be made when the current machines are replaced to ensure that the extraction ventilation is upgraded to suit the new equipment. The Redwing Sander/Grinders need to have extraction ventilation installed that is not dependent on the machine operating such as the current bag system. It needs to surrounds the working area of the machine and be able to capture the dust particles as they are generated.

The other major issue identified early on in the project was the current quality of Material Safety Data Sheets available in the laboratory. They need to be replaced with more current sheets and also need the Australian guidelines for Safety Data Sheets

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