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HEALTH & SAFETY LABORATORY

A report of a small survey to assess occupational exposure to paper tissue dust in the UK

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Summary

Aim

Provide the Health and Safety Executive's (HSE) Sector for Paper and Printing and the Health and Safety Commission's (HSC) Paper and Board Industry Advisory Committee (PABIAC) with sufficient valid data on current operator exposure to paper tissue dust and details of in-use and possible alternative control strategies, together with probable reasons for the success or failure of control, to enable them to develop an effective control strategy for the industry, and issue robust guidance accordingly .

Objectives

Visit 4 tissue manufacturing mills and 5 tissue conversion facilities recommended by the HSE's Field Operations Directorate (FOD) in order to:

1. Carry out full occupational hygiene exposure assessment for paper tissue dust.

2. Carry out air monitoring as necessary to determine operator personal exposure.

3. Discuss with local management / H&S advisors the effectiveness of current and past control measures/strategies used by the company and obtain their views on other options as may be appropriate.

Main Findings

General

1. All companies considered the major H&S hazard from tissue dust is fire.

2. All companies realized there were potential risks to operator health due to inhalation of excessive amounts of tissue dust and had policies in place to control exposure.

3. The amount of dust generated during tissue manufacture and conversion is dependent on many factors. These include:

- Type of pulp used (virgin pulp, more dust)

- Scale of production

- Softness of the tissue. (smaller particles, therefore dustier)

- Moisture content (less moisture, more dust generated)

- Amount of additives (wet strength additives reduce dust)
- Grammage (weight per unit area)
- Speed of rollers (faster speed, more dust)
- Level of expertise of the company paper maker.

4. Personal exposure is likely to vary widely from day to day, depending on the type of tissue being manufactured or converted. Undoubtedly the sites with the biggest dust exposure problems seen on this survey were those running the softest product.

5. 12 hour shifts are common.

Tissue Manufacture

1. Operator exposure to total inhalable particulate (TIP) was measured at 6 paper making machines.

2. Airborne dust was seen to be generated at all stages of the process between the removal of the web of dried tissue from the Yankee wheel by the doctor (creaping) blade and the final reel-up. There was a buildup of dust around the dry end of the machine through the shift with or without Local Exhaust Ventilation being installed

3. Blowing down with air lines was the method of cleaning down at all sites visited.

4. In Tissue Manufacturing halls without LEV or dilution ventilation personal exposures to total inhalable particulate (TIP) were between 3.4 & 21 mg/m^3 during normal production however when allowance was made for periodic blowing down and 12 hour shifts 8 hour time weighted average (8-hr TWA) exposures were calculated as being between 8.9 & 34.4 mg/m^3. The COSHH limit of 10 mg/m^3 (8-hr TWA) is appropriate for inhalable paper tissue dust. These levels are potential exposures and do not take into account the effectiveness of any respiratory protective equipment that may have been worn. Where LEV or dilution ventilation had been introduced personal exposures to total inhalable particulate (TIP) were between 1.8 & 7.9 mg/m^3 during normal production however when allowance was made for periodic blowing down and 12 hour shifts 8 hour time weighted average (8-hr TWA) exposures were calculated as being between 3.0 & 19.5 mg/m^3.

5. The highest exposures were recorded for operators who included cleaning down with compressed air lines as part of their work pattern. Levels of between 14.5 & 251 mg/m^3 were measured during these short term activities. These levels are

potential exposures and do not take into account the effectiveness of any respiratory protective equipment that may have been worn.

6. Personal exposure to respirable dust was not measured as part of this survey. However, pairs of static samplers strategically sited indicated that the respirable fraction of the TIP is likely to be well below 40%, indicating that if TIP is adequately controlled respirable dust will also be adequately controlled.

Conversion

1. Operator exposure to total inhalable particulate (TIP) was measured at 5 conversion facilities.

2. The major sources of dust were the rewind machines. A dust cloud was seen to be generated each time the web of paper passed across a roller. After several hours production dust was seen to have accumulated on, beneath, and around the machines if LEV had been installed or not.

3. Blowing down with air lines was the method of choice for cleaning down at most sites visited. However, one had banned the use of airlines for cleaning during normal production and another had restricted airline use to colour changes. The general belief was that machine clean-down by vacuuming was to slow, particularly in the larger establishments, and would take far to long. The places where vacuuming was used tended to be either small establishments or vacuuming only used for area cleaning by dedicated personnel. However, after the HSL visit, one larger site decided to experiment by taking the airlines out altogether in one area and only use vacuum cleaning and brushing down methods. It is understood that at first there was resistance from the operators, but after a while they accepted that the method was effective and has resulted in less frequent clean-downs, so the time factor is less of a problem than first thought. Plans are in place to extend the experiments. This site has very large, powerful vacuum cleaners fit for the purpose. They receive regular cleaning and maintenance. Subjectively, many areas such as switchboxes are very awkward to access and it is encouraging that a prohibition of blowing down has been so readily accepted. Other sites had reported, serious, clogging problems with vacuum cleaners and believed the method to be impractical. Some other places obtained vacuum points from the extraction system. Operators tended to think that this method was not powerful enough to be effective. This supposition is probably correct as the extraction system is likely to be high volume low velocity therefore unsuitable for cleaning purposes.

4. Some sites used brooms or had scrapers for cleaning floors. Scrapers were effective in cleaning very even floors and subjectively raised little dust. Although no measurements were taken for this specific activity When sweeping with brooms short term operator exposures were measured at between 12 & 20 mg/m^3. Occasional, careful, short term sweeping up is not believed to be a major contributor to overall exposure.

5. Operators of rewind machines with LEV had personal exposures to total inhalable particulate (TIP) between 8.3 & 27.9 mg/m^3 during normal production however when allowance was made for periodic blowing down and 12 hour shifts 8 hour time weighted average (8-hr TWA) exposures were calculated as being between 10.1 & 40.5 mg/m^3. The COSHH limit of 10 mg/m^3 (8-hr TWA) is appropriate for inhalable paper tissue dust. These levels are potential exposures and do not take into account the effectiveness of any respiratory protective equipment that may have been worn. Where LEV or dilution ventilation had not been introduced personal exposures to total inhalable particulate (TIP) were between 2.2 & 18.3 mg/m^3 during normal production and even when allowance was made for periodic blowing down and 12 hour shifts 8 hour time weighted average (8-hr TWA) exposures were calculated as still being between 2.2 & 18.3 mg/m^3. These figures show that the introduction of LEV alone will not necessesserily effectively control exposure. The site where the extensive LEV was least effective in controlling personal exposures had the largest plant of all. Operators often have to do running maintenance due to web breaks etc. They get necessarily close to the source of emission and receive very large exposures at these times, which invariably defeats the LEV. The one day exposure assessments during the current exercise could not even begin analyzing these wildly fluctuating exposure patterns. However it was very interesting to note that the site with the most up to date plant recorded the lowest exposures. It may well be that this was because the plant was more reliable resulting in less of these maintenance excursions.

6. The highest exposures were recorded for operators who included cleaning down with compressed air lines as part of their work pattern. Levels of between 6.4 & 235 mg/m^3 were measured during these short term activities. These levels are potential exposures and do not take into account the effectiveness of any respiratory protective equipment that may have been worn.

7. Personal exposure to respirable dust was not measured as part of this survey. However, pairs of static samplers strategically sited indicated that the respirable fraction of the TIP is likely to be well below 40%, indicating that if TIP is adequately controlled respirable dust will also be adequately controlled.

8. The wide range of exposures for operators carrying out essentially similar tasks on similar products is probably explained by differences in scale of production and in time spent on maintenance. This will vary considerably from day to day.

9. No other operators in the conversion facilities visited had operator exposures in excess of 10mg/m^3 (8-hr TWA)

Conclusions

1. The use of airlines to blow down is the major contribution to overall exposure in this industry.

2. Vacuum cleaning and sweeping are practicable alternatives to cleaning down with airlines

3. The use of air conditioned operator refuges is the most effective control measure during tissue manufacture.

4. Operator exposure in tissue manufacture can be further controlled by the introduction of LEV and/or dilution ventilation together with a robust RPE use policy for short term dust generating activities such as maintenance and cleaning down.

5. Operator exposure during conversion activities is generally well controlled, with the exception of operators of higher speed winders (i.e.>400m/min)

6. Control of exposure during high speed rewinding is not straightforward. The introduction of LEV will not necessarily control overall exposure. In extreme cases the introduction of LEV and the use of an extracted enclosure may not effectively control overall exposure. In these extreme cases there may be no viable alternative to the use of RPE for all tasks except basic machine minding.

7. Blowing down remains the most significant source of exposure 30 mins at 200 mg/m3 is equivalent to 12.5 mg/m3 for 8 hours

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1. INTRODUCTION

The problem of excessive exposure to paper tissue dust in factories manufacturing tissue products has recently been raised, independently, by several HSE Inspectors of Health & Safety. Trade associations have also raised the issue at Paper and Board Industry Advisory Committee (PABIAC) health subcommittee meetings. Reporting that dust levels tend to be high (often above the COSHH general dust exposure limits). It was also reported that many workers have complained of (nonspecific) symptoms, but the long term effects, if any, are unknown. There has been a general agreement at these meetings that basic information on levels of dust exposure is required, including samples of peak levels. Tasks such as cleaning down and sweeping up have been highlighted as possible significant contributors to overall exposure. However it has also been suggested that the trend towards the production of softer tissues has resulted in higher dust levels. It was agreed at these meetings that HSE would examine the problem.

The Paper and Printing National Interest Group (NIG) decided that the best way forward was a local project to gather information on the level of exposure with the aim of proposing a control strategy. This work is currently being carried out by the HSE's Field Operations Directorate (FOD) North West Region Specialist Group (NWRSG) and the bulk of the information will be gathered from companies within the North West Region.

However to ensure the survey was representative the Health & Safety Laboratory was asked by the NIG to visit a representative selection of sites situated in other parts of the country.

2. STRATEGY

2.1. Scope

Visit 4 tissue manufacturing mills and 5 tissue conversion facilities recommended by the HSE's Field Operations Directorate (FOD) in order to:

1. Carry out full occupational hygiene exposure assessment for paper tissue dust.

2. Carry out air monitoring as necessary to determine operator personal exposure.

3. Discuss with local management / H&S advisors the effectiveness of current and past control measures/strategies used by the company and obtain their views on other options as may be appropriate.

All processes, in both primary manufacture and conversion, with a significant dust generating potential were to be examined and any control measures in place assessed. Personal air sampling was to be carried out as necessary to determine operator exposure to Total Inhalable Particulate (TIP). Previous work in this area has shown that respirable dust is not the major contributor to overall exposure, so to avoid encumbering operators with two sets of sampling equipment, respirable dust sampling was not to be carried out. However at least one set of static samples for TIP/respirable dust were to be taken in parallel at a strategic location to determine the likely TIP/respirable dust ratio and thus test this supposition.

2.1. Sampling and Analysis

Sampling and analysis was carried out according to the HSE guidance booklet, Methods for the Determination of Hazardous Substances No.14/3 - General Methods For Sampling and Gravimetric Analysis of Respirable and Inhalable Dust (MDHS14/3) using the IOM sampling head and Higgins-Dewell type cyclone sampler followed by gravimetric analysis.

3. FINDINGS - MANUFACTURE

3.1. Company 1

This company operates from a very large site. They are a well established company who have expanded significantly recently. They manufacture bulk rolls of tissue, of various grades There is one tissue manufacturing machine and a second, brand new, state of the art, machine is currently being installed. The existing machine is less than 3 years old. Production is approximately 20,000 tonnes per year. There are about 20 mill workers. 5 crews work a three, 8 hr, shift system. Overtime can extend shift length to 12 hours. Shifts include a total of 60 minutes breaks, usually taken in the works canteen. The company manufacture a premier quality soft tissue and supermarket "own label" quality products.

3.1.1. The Site

The buildings are modern and spacious and mostly constructed from brick and steel under a pitched roof. They are in a very good state of cleanliness and repair. Lighting is good and the large workrooms potentially have a very pleasant working environment. The manufacturing hall is approximately 25m x 100m x 10m to eves, rising to 13m at the gable.

3.1.2. The Process

Tissue is manufactured from a mixture of virgin and broke material. Pulp is prepared in a segregated area at one end of the premises. It is then fed to the tissue making machine through an enclosed system. There is one conventional tissue making machine, essentially comprising headbox, wire, transfer felt, Yankee drier and roll-up. The machine is less than three years old. Machine conditions vary from day to day but typically run at 1300 m/min producing tissue of 20 g/m^2 and 6%+ moisture content. Size of rolls is 100 inch. Waste is returned automatically to the wet end for recycling.

The bulk rolls are transferred to dispatch manually, using an overhead crane. 3 - 4 operators run the production line. These are a crew leader, dryer man, machine man, and FLT operator.

3.1.3. Sources of dust

A visible dust cloud is generated as the doctor blade removes the web of dry tissue from the Yankee wheel and each time the web passes over a roller to and including the roll-up.

From time to time the web will break on the tissue making machine. At these times thick dust clouds are generated. Necessarily the operators need to get close to the machine to re-thread

the web at these times and are exposed to substantial levels of dust. These operations take several minutes to complete.

There is a certain amount of vibration during reel changing operations and the potential for a dust cloud to be formed at this time is high.

3.1.4. Cleaning

Operators use air lines periodically to clean off accumulations of dust from paper making machines Substantial dust clouds can generated at these times, which can last from a few minutes to several hours for a major clean down. The dry ends are routinely blown down at least once each shift. This can take up to half an hour. Once the dust is on the floor the laying dust is swept towards the wet end and then hosed away.

3.1.5. Controls

At present there is no local exhaust ventilation installed on the paper making machine. A comprehensive system is due to be installed shortly. This will consist of slot exhausts on the doctor blade, thicknessers, and rollers, including reel-up. The occupiers are confident this will reduce operator exposure and have the knock on benefit of a cleaner product being supplied to the conversion plant, thus helping to control exposure there. The brand new machine being installed adjacent will have this system built in by the suppliers.

Another major control measure in the manufacturing area is the use of a control room refuge. This offers good protection from dust and noise. Time spent in the control room will vary considerably according to the smoothness of production. The routine need to enter the workroom is to change rolls, say 5 minutes every 20- 30 minutes. However breaks. doctor blade changes. and other interruptions will necessitate extended sessions in the workroom. Operators might expect to spend 75 - 80% of there time in the refuge.

Air lines are pressure regulated to 6 bar and are fitted with auto cut off. These measures are believed to minimize the dust cloud raised when blowing down.

The manufacturing hall is supplied with dilution ventilation. There are two extractors at high level and wall supply vents at low level. These give a planned 10 air changes per hour. Smoke tube test confirmed air movement to be present. Humidity was high (>70%). This will help dust suppression.

3.1.6. Respiratory Protection

Filtering face-piece respirators are available, and use is compulsory for blowing down. They were seen to be used by most operators during blowing down.

3.1.7. Protective Workware

Overalls are worn and there is regular in house laundry. Safety boots/shoes and hearing protection are compulsory. as are goggles when blowing down. Disposable coveralls are also available.

3.1.8. Training

There is health and safety induction and a rolling H&S training programme mostly in house. There are usually 4 sessions per year with written examinations at the end. There is specific training for new plant.

3.1.9. Results

Results and Operator 8-hr time weighted average exposures (8-hr TWA) are detailed in appendix 1 and summarized below.

1. In the Tissue Manufacturing hall personal exposures to total inhalable particulate (TIP) were between 3.0 & 7.1 mg/m^3 8 hour time weighted average (8-hr TWA). The COSHH limit of 10 mg/m^3 (8-hr TWA) is appropriate for inhalable paper tissue dust.

2. The highest exposures were recorded for operators who included cleaning down with compressed air lines as part of their work pattern. Levels of between 49 & 92 mg/m^3 were measured during these short term activities. These levels are potential exposures and do not take into account the effectiveness of any respiratory protective equipment that may have been worn.

3. A static sampler for TIP sited alongside the reel-up gave a value of 9.8 mg/m^3. This sampler was in the area most frequented by operators during normal operation. Unfortunately a parallel sample for respirable dust was spoiled so no absolute level was recorded. However calculation shows that the level could have been no higher than 1.9 mg/m^3. Therefore the percentage respirable dust was 19% or lower. Subjective study of the filter suggests that the figure is likely to be much lower. Similar samples taken at other premises manufacturing similar grades of tissue indicated that the respirable fraction of the TIP is likely to be low.

3.2. Company 2

This company manufacture bulk rolls of tissue, of various grades There is one, Beloit, conventional tissue making machine. The machine is 6 years old. Production is approximately 30,000 tonnes per year in 2.5 tonne rolls. They employ a total of around 66. 5 crews work a two 12 hour shift system,. Shifts include a total of 60 minutes breaks, usually taken in the works. There are about 25 mill workers, 5 per shift. The company considers these operators to be the primary exposed group. The company manufacture both "premier" quality soft toilet and toweling tissues

3.2.1. The Site

Tissue has been made at the large site for many years, but has only been owned by the present company since relatively recently. The buildings are modern and spacious and mostly constructed from brick and steel under a pitched roof. The machine hall is approximately 80m x 15m x 8m to eves. They are in a very good state of cleanliness and repair. There were no major accumulations of dust. Lighting is good and the large workrooms potentially have a very pleasant working environment. On the day of the visit the air temperature of the workroom was 15.4°C and the RH 49%. at the dry end.

3.2.2. The Process

The Beloit tissue making machine is on the first floor. It is fitted with a 3m Yankee wheel 3.3m wide. The Yankee is steam heated to 180°C at 155psi. There is a gas powered hood at 470°C. Tissue is manufactured from 100% waste material. Pulp is prepared in a segregated area at one end of the premises. It is then fed to the tissue making machine through an enclosed system. It is a conventional machine, essentially comprising headbox, wire, transfer felt, Yankee drier and roll-up The machine is 6 years old. Machine conditions vary from day to day but typically run at 1200 m/min producing tissue of 20 g/m^2 and 5% moisture content. Waste is returned automatically to the wet end for recycling.

The bulk rolls are manually covered in polythene sheeting, transferred manually, using an overhead crane, to a ground floor dispatch area

5 operators run each production line, with three at the dry end. These are a crew leader and two machine operators.

3.2.3. Sources of dust

A visible dust cloud is generated as the doctor blade removes the web of dry tissue from the Yankee wheel and each time the web passes over a roller to and including the roll-up. The Tyndall beam effect was used to verify this.

Approximately every 30 minutes a reel change is made. A visible dust cloud was seen to be generated by this operation.

From time to time the web will break on the tissue making machine. At these times thick dust clouds are generated. Necessarily the operators need to get close to the machine to re-thread the web at these times and are exposed to substantial levels of dust. These operations take several minutes to complete.

3.2.4. Cleaning

Operators use air lines periodically at all stages of production to clean off accumulations of dust from paper making machine, thicknesser, surroundings and floors. Substantial dust clouds are generated at these times, which can last from a few minutes to several hours for a

major clean down. Major dust accumulations are not allowed to build up in accessible areas around the machine.

The dry end of the paper making machines are routinely blown down towards the end of each shift. This can take up to half an hour. Once the dust is on the floor the laying dust is blown towards the wet end from where it is scraped and finally hosed away. No brooms are used

The hall has a major blow-down of the overhead girders every 5-6 weeks. This is carried out during planned shutdowns. The operators use powered RPE for this operation. This work was traditionally carried out during production periods, but that practice is now prohibited.

3.2.5. Controls

There is no local exhaust ventilation installed on the paper making machine and this has never been tried at this site.

The major control measure in the manufacturing area is the use of a control room refuge. This offers protection from dust and noise. Time spent in the control room will vary considerably according to the smoothness of production. The routine need to enter the workroom is to change rolls, say 5 minutes every 30 minutes. However breaks, doctor blade changes, and other interruptions will necessitate extended sessions in the workroom. Operators might expect to spend 50-70% of there time in the refuges.

There is introduced dilution ventilation in the form of roof fans. The workroom is very spacious, which allows some dilution of the dust cloud. Smoke tube tests showed that there was some air movement in all areas tested, with the flow being towards the wet end. At various times over the visit a dust haze was noticeable around the reel change/take off area. However the sampling team did not feel particularly uncomfortable when working in this area. This haze did disperse from time to time.

There is a water jet at the second doctor blade.

Air lines are pressure regulated and are fitted with lances. These measures are believed to minimize the dust cloud raised when blowing down.

3.2.6. Respiratory protection

Filtering face-piece respirators (3M8812, FFP1) are available and use is compulsory when working close to the dry end of the machine (reel change etc.). They were seen to be used by the operators working during blowing down. The man actually blowing down used a Racal Dustmaster powered respirator.

3.2.7. Protective Workwear

Uniforms are worn and there is regular in house laundry. Safety boots/shoes and hearing protection are compulsory, as are goggles when blowing down. Disposable coveralls are also available.

3.2.8. Training

There is health and safety induction and a rolling H&S training programme including external providers.

3.2.9. Results

Results and operator 8-hr time weighted average exposures (8-hr TWA) are detailed in appendix 1 and summarized below.

1. In the Tissue Manufacturing area personal exposures to total inhalable particulate (TIP) during normal production were between 7.2 & 34.27 mg/m^3. 8 hour time weighted average (8-hr TWA). The COSHH limit of 10 mg/m^3 (8-hr TWA) is appropriate for inhalable paper tissue dust. These were calculated as potential exposures and do not take into account the protection offered by any respiratory protection that may have been worn for some tasks.

2. The highest exposures were recorded for an operator who included cleaning down with compressed air line as part of his work pattern. A personal exposure of 251 mg/m^3 was measured during this short term activity. Workers operating the machine during the blow-down had measured exposures of between 10.2 & 12.7 mg/m^3. These levels are potential exposures and do not take into account the effectiveness of any respiratory protective equipment that may have been worn.

3. A static sampler for TIP sited alongside the reel-up of the machine gave a value of 20.1 mg/m^3. This sampler was in the area most frequented by operators during normal operation. A parallel sampler for respirable dust gave a value of 0.26 mg/m^3. This indicated that the respirable fraction of the TIP is likely to be low.

4. There were no engineering control measures in place specifically for dust. However there were roof fans which provided some air movement within the production hall.

3.3. Company 3

At this site the company manufacture bulk rolls of tissue, of various grades There are two tissue making machines. One makes a particularly soft grade of tissue. The machines are 20 - 30 years old. Production is approximately 80.000 tonnes per year. They employ a total of around 60 mill workers. 5 crews work a three shift system, 07:00 - 14:00, 14:00 - 22:00, and 22:00 - 07:00. Shifts include a total of 60 minutes breaks, usually taken in the works canteen. The company manufacture a premier quality soft tissue and a number of supermarket "own label" quality products. However the bulk of production is very soft tissue.

3.3.1. The Site

Tissue has been made at the site for many years, but has only been owned by the present since relatively recently. The buildings are modern and spacious and mostly constructed from brick

and steel under a pitched roof. They are in a very good state of cleanliness and repair. Lighting is good and the large workrooms potentially have a very pleasant working environment.

3.3.2. The process

Tissue is manufactured from a mixture of virgin, recycled and broke material. Pulp is prepared in a segregated area at one end of the premises. It is then fed to the tissue making machines through an enclosed system. There are two tissue making machines side by side. One makes a particularly soft grade of tissue. The machines are 20 - 30 years old. Machine conditions vary from day to day but typically run at 1100 m/min producing tissue of 18 - 25 g/m^2 and 2%+ moisture content. Waste is returned automatically to the wet end for recycling.

The bulk rolls are transferred manually, using an overhead crane, to two adjacent winders which produce a single roll of two ply tissue from two single ply rolls. These winders run at 750-900 m/min. The rolls are transferred to the conversion facilities by fork lift truck.

Three operators run each production line. These are a crew leader, a control operator, and a winder operator.

3.3.3. Sources of dust

A visible dust cloud is generated as the doctor blade removes the web of dry tissue from the Yankee wheel and each time the web passes over a roller to and including the roll-up.

Similarly a dust cloud is generated at each roller of the doubling winders. The Tyndall beam effect was used to verify this.

From time to time the web will break on the tissue making machine. At these times thick dust clouds are generated. Necessarily the operators need to get close to the machine to re-thread the web at these times and are exposed to substantial levels of dust. These operations take several minutes to complete.

Similarly the web may break during rewinding operations. Here the machines are stopped to allow re-threading.

3.3.4. Cleaning

Operators use air lines periodically at all stages of production to clean off accumulations of dust from paper making machines and floors. Substantial dust clouds are generated at these times, which can last from a few minutes to several hours for a major clean down.

The dry end of the paper making machines are routinely blown down towards the end of each shift. This can take up to half an hour. Operators were seen to use vacuum cleaners to clean some surfaces. Once the dust is on the floor the laying dust is hosed away.

3.3.5. Controls

There is no local exhaust ventilation installed on the paper making machines.

Rotorclone extractors are fitted in the floor beneath the winders. These are generally considered to reduce dust levels. On the day of sampling the rotorclones beneath P1 were working but those beneath P2 were inoperative.

The major control measure in the manufacturing area is the use of control rooms and refuges. These offer protection from dust and noise. Time spent in the control rooms and refuges will vary considerably according to the smoothness of production. The routine need to enter the workroom is to change rolls, say 5 minutes every 20- 30 minutes. However breaks, doctor blade changes, and other interruptions will necessitate extended sessions in the workroom. Operators might expect to spend 50% of there time in the refuges.

Air lines are pressure regulated and are fitted with lances and auto cut off. These measures are believed to minimize the dust cloud raised when blowing down.

There is no introduced general ventilation in the production mill. The mill is very spacious, which allows some dilution of the dust cloud. Smoke tube tests showed that there was some air movement in all areas tested. A dust haze was noticeable throughout the premises. However the sampling team did not feel particularly uncomfortable when working in this area. This haze did disperse from time to time.

3.3.6. Respiratory protection

Filtering face-piece respirators are available, but use is not compulsory. They were seen to be used by all operators during blowing down.

3.3.7. Protective Workwear

Uniforms are worn and there is regular in house laundry. Safety boots/shoes and hearing protection are compulsory, as are goggles when blowing down. Disposable coveralls are also available.

3.3.8. Training

There is health and safety induction and a rolling H&S training programme mostly in house.

3.3.9. Results

1. In the Tissue Manufacturing area personal exposures to total inhalable particulate (TIP) were between 3.9 & 15 mg/m^3 8 hour time weighted average (8-hr TWA). The COSHH limit of 10 mg/m^3 (8-hr TWA) is appropriate for inhalable paper tissue dust.

2. The highest exposures were recorded for operators who included cleaning down with compressed air lines as part of their work pattern. Levels of between 74 & 100 mg/m^3 were measured during these short term activities. These levels are potential exposures and do not take into account the effectiveness of any respiratory protective equipment that may have been worn.

3. A static sampler for TIP sited alongside the reel-up of machine 2 gave a value of 6.7 mg/m^3. This sampler was in the area most frequented by operators during normal operation (outside refuge) but, due to operational difficulties, was placed well above breathing height (approx. 3m above floor) Unfortunately a parallel sampler for respirable dust malfunctioned so no level was recorded. however similar samples taken at other premises manufacturing similar grades of tissue indicated that the respirable fraction of the TIP is likely to be low.

4. Rotorclone extractors are fitted beneath the winders. These are generally considered to reduce dust levels. On the day of sampling the rotor clones beneath P1 were working but those beneath machine 2 were inoperative. Air monitoring showed little difference between exposures of the two winder operators. This was probably because of the major contribution short term blowing down has on overall exposure.

5. There were no other engineering control measures in place specifically for dust. It is understood that, when new, machine 2 winder was fitted with slot exhausts Apparently this was effective to start with but quickly clogged up, became very difficult to maintain, so was eventually discarded.

3.4. Company 4

There has been a mill on the site for many years, but has only been in the ownership of this company since relatively recently. There have been significant increases in productivity made, which is still being implemented. This has resulted in a dramatic reduction in manpower levels. They currently employ approximately 60 mill operators. 5 crews work a 2 x 12 hour shift system. Shifts include a total of about 60 minutes breaks, usually taken in the works canteens. There are three tissue manufacturing machines which manufacture bulk rolls of tissue, of various grades. One machine would typically produce 29.000 tonnes per year. The company manufacture a premier quality extra soft tissue.

3.4.1. The Site

The large complex of buildings are modern and spacious and mostly constructed from brick and steel under a pitched roof. They are in a very good state of cleanliness and repair. Lighting is adequate and the large workrooms potentially have a pleasant working environment. There are two manufacturing halls.

3.4.2. The process

Tissue is manufactured from a mixture of pulps. Pulp is prepared in a segregated area at one end of the premises. It is then fed to the tissue making machines through an enclosed system. There are three conventional tissue making machines, essentially comprising headbox, wire, transfer felt, Yankee drier and roll-up. Machine 1 was under maintenance and not working on the day of the visit. This made for very restricted access to machine 2, so this machine was not seen. The third machine was a Beloit-Walmsley, which produced supersoft tissue. Machine conditions vary from day to day but typically run at 1100 m/min producing tissue of 23 g/m^2 and 4.2%+ moisture content. Size of rolls is 133 inch. Waste is returned automatically to the wet end for recycling.

3 operators run the production line. These are a crew leader, dryer man, and machine man.

3.4.3. Sources of dust

A visible dust cloud is generated as the doctor blade removes the web of dry tissue from the Yankee wheels and each time the web passes over a roller to and including the roll-up.

From time to time the web will break on the tissue making machine. At these times thick dust clouds are generated. Necessarily the operators need to get close to the machine to re-thread the web at these times and are exposed to substantial levels of dust. These operations take several minutes to complete.

There is a certain amount of vibration during reel changing operations and the potential for a dust cloud to be formed at this time is high.

3.4.4. Cleaning

Operators use air lines periodically to clean off accumulations of dust from paper making machines, beams etc. Substantial dust clouds are generated at these times, which can last from a few minutes to several hours for a major clean down.

The dry end of the paper making machines and their immediate surroundings are routinely blown down at least once each shift. This can take up to half an hour. Once the dust is on the floor the laying dust is swept towards the wet end and then hosed away.

Major clean-downs with air are carried out by contractors. None were seen during the visit.

3.4.5. Controls

A comprehensive extraction system has been installed on machine 3. This consists of slot exhausts above and below the Yankee, the thicknesser, and all rollers, including reel-up.

Another major control measure in the manufacturing area is the use of a control room refuge. This offers good protection from dust and noise. Time spent in the control room will vary considerably according to the smoothness of production. The routine need to enter the workroom is to change rolls, say 5 minutes every 20- 30 minutes. However breaks, doctor blade changes, and other interruptions will necessitate extended sessions in the workroom. Operators might expert to spend at least 50% of their time in the refuge.

There is no supplied with dilution ventilation in the manufacturing hall. Smoke tube test confirmed air movement to be present.

3.4.6. Respiratory protection

Filtering face-piece respirators are available, and use compulsory for blowing down. They were seen to be used by most operators during blowing down

3.4.7. Protective Workwear

Overalls are worn and there is regular in house laundry. Safety boots/shoes and hearing protection are compulsory, as are goggles when blowing down. Disposable coveralls are also available.

3.4.8. Training

There is health and safety induction and a rolling H&S training programme mostly in house, IOSH based. There are safety and PPE manuals available. A safety manual was seen beside the canteen entrance. The company work to HSG65 requirements.

3.4.9. Results

Results and Operator 8-hr time weighted average exposures (8-hr TWA) are detailed in appendix 1 and summarized below.

1. In the Tissue Manufacturing hall personal exposures to total inhalable particulate (TIP) were between 1.8 & 7.9 mg/m^3 during normal production however when allowance was made for periodic blowing down and 12 hour shifts 8 hour time weighted average (8-hr TWA) exposures were calculated as being between 5.6 & 19.5 mg/m^3. The COSHH limit of 10 mg/m^3 (8-hr TWA) is appropriate for inhalable paper tissue dust. These levels are potential exposures and do not take into account the effectiveness of any respiratory protective equipment that may have been worn.

2. The highest exposures were recorded for operators who included cleaning down with compressed air lines as part of their work pattern. Levels of between 48 & 123 mg/m^3 were measured during these short term activities. These levels are potential exposures and do not take into account the effectiveness of any respiratory protective equipment that may have been worn.

3. A static sampler for TIP sited alongside the reel-up control panel gave a value of 11.6 mg/m^3. This sampler was in an area most frequented visited by operators during normal operation. Unfortunately a parallel sample for respirable dust was spoiled so no absolute level was recorded. However calculation shows that the level could have been no higher than 1.9 mg/m^3. Therefore the percentage respirable dust was 17% or lower. Subjective study of the filter suggests that the figure is likely to be much lower. Similar samples taken at other premises manufacturing similar grades of tissue indicated that the respirable fraction of the TIP is likely to be low.

4. MANUFACTURE - RESULTS SUMMARY

The minimum, maximum, median and 95%ile operator exposures during manufacture are shown below in table 1.

Table 1

	Exposure No Ventilation mg/m3	8hr TWA No Ventilation mg/m3	Exposure With Ventilation mg/m3	8hr TWA With Ventilation mg/m3	Blowing Down mg/m3
n	12	12	7	7	8
Min	3.4	3.9	1.8	3	14
Max	21	34.3	7.9	19.5	251
Median	7.2	8.9	3.6	6.4	83
95%ile	16.4	34.3	7.0	15.9	206

The 8hr TWA figures include an element for blowing down and an allowance for extended shifts where needed. The results clearly indicate that the introduction of ventilation, either LEV or dilution, will dramatically reduce overall exposure.

5. FINDINGS - CONVERSION

5.1. Company 1

This company operates from a very large site. They are a well established company who have expanded significant recently. Bulk rolls of tissue are converted into toilet and kitchen rolls in three conversion halls. Approximately 10,000 tonnes of tissue are converted annually. There are about 90 operators. 5 crews work a three, 8 hr, shift system. Overtime can extend shift length to 12 hours. Shifts include a total of 60 minutes breaks, usually taken in the works canteen. . The company manufacture a "premier" quality soft tissue and other "own label" quality products.

5.1.1. The Site

The buildings are modern and spacious and mostly constructed from brick and steel under a pitched roof. They are in a very good state of cleanliness and repair. Lighting is good and the large workrooms potentially have a very pleasant working environment.

5.1.2. The Process

There are currently 5 conversion lines located in three halls. Machines are modern, some being only 18 months old. Bulk rolls are delivered to winders by fork lift truck (FLT). They are then manually loaded onto the unwind roller using a hoist. The winder converts the bulk roll to a toilet roll sized "log", which is then automatically ejected and transferred by conveyor and an accumulator to a "log saw" which cuts the rolls to length, then they are conveyed on to packaging machines and in turn to a palleting area where they are made ready for dispatch. Much of the packing and palleting is carried out by robots. Conversion winders run at different speeds according to type and grade of tissue. Machines typically run at between 150 - 450 m/min. About 3 operators run a conversion line.

5.1.3. Sources of dust

The principle source of dust during production is the web of tissue passing at speed through the winders rollers. Generally the softer the tissue the greater is the potential for dust generation. Additionally the faster the web runs the more dust is generated. The Tyndall beam effect was used to verify this. The log saws are also a potential source of dust, however, subjectively, to a lesser degree.

The web may break during rewinding operations. Here the machines are stopped to allow re-threading. Operators do not have to enter the machines for this operation as they are fitted with paper threading belts.

5.1.4. Cleaning

Operators use air lines periodically to clean off accumulations of dust from winders, etc. Substantial dust clouds can generated at these times, which can last from a few minutes to several hours for a major clean down.

The winders are routinely blown down at a paper change. This can also take up to half an hour. Other blowing down is restricted to activities essential to maintain production. Once the blown dust is on the floor it is swept up with brushes. Vacuum cleaners are used for intricate areas such as switch-boxes.

Major clean-downs with air are planned. Production lines are blown down on a Saturday afternoon. Production is suspended for this activity. There are also major blow-downs of overhead girders, fittings etc. on a rolling 5 week Saturday afternoon cycle. Roof voids are left open because suspended ceilings are deemed a fire risk as significant quantities of dust can build up above them.

5.1.5. Controls

There is no local exhaust ventilation installed on the winding machines.

Log core and roll changes are automated so operators to not need to spend time in these areas. which is a major source of dust.

All machines have partial enclosures, primarily for safety and as noise reduction measures. However these enclosures will offer some protection to operators from dust during normal production and so reduce overall exposure.

Much of the production line has been automated, including use of robotics. These measures serve to distance operators from the primary source of dust and so reduce their overall exposure.

Most other stages of production have safety enclosures. Log saws are enclosed for safety and are fitted with powerful extraction to remove roll ends, swarf, etc. This effectively controls dust generation during normal production. and the make up air supply units provide air movement within the conversion halls. Smoke tube test confirmed air movement to be present.

5.1.6. Respiratory protection

Filtering face-piece respirators are available, and used compulsory for blowing down. They were seen to be used by most operators during blowing down

5.1.7. Protective Workwear

Overalls are worn and there is regular in house laundry. Safety boots/shoes and hearing protection are compulsory, as are goggles when blowing down. Disposable coveralls are also available.

5.1.8. Training

There is health and safety induction and a rolling H&S training programme mostly in house. There are usually 4 sessions per year with written examinations at the end. There is specific training for new plant.

5.1.9. Results

Results and Operator 8-hr time weighted average exposures (8-hr TWA) are detailed in appendix 2 and summarized below.

1. In the tissue conversion halls personal exposures of rewind machine operators to total inhalable particulate (TIP) were between 1.7 & 6.9 mg/m^3 8 hour time weighted average (8-hr TWA).

2. In the tissue conversion halls the personal exposure of a peripatetic fitter to total inhalable particulate (TIP) was 0.6 mg/m^3 8 hour time weighted average (8-hr TWA). This would be a good indication of the expected exposures of other workers in the area such as packers.

3. A colour change blow-down was undertaken on the day of the visit. This produced an operator personal exposure of 28 mg/m^3. This task took 15 minutes. The measured levels are potential exposure and do not take into account the effectiveness of any respiratory protective equipment that may have been worn while carrying out the work.

4. A static sampler for TIP sited on the reel change control panel of the No. 5 (Perini) rewind machine gave a value of 3.7 mg/m^3. A parallel sampler for respirable dust was spoiled, but could not have been greater than 1.7 mg/m^3. The percentage respirable dust was therefore less than 46%. This is figure is significantly higher than average and should be treated with caution.

5. The wide range of exposures for operators carrying out essentially similar tasks on similar products (from approx. 1.7 to 6.9 mg/m^3) is probably explained by differences in time spent on maintenance. This will vary from day to day.

5.2. Company 2

This company buy in bulk rolls of tissue, of various grades, of approximately one tonne each, from the mill and process them into toilet rolls and boxes, paper handkerchiefs, hand towels etc., of all shapes and sizes. Production targets are set at 10,000 cases per day, but the current level is around 9,000 cases per day. They employ a total of around 200 on a three shift system, 07:30 - 16:00, 16:00 - 00:30, and 00:30 - 07:30. Shifts include a total of 40 minutes breaks, usually taken in the works canteen. There are about thirty production workers on each shift ten of which operate re-reeling machines. The company considers these operators to be the primary exposed group, with the rest of the shift receiving secondary exposure. The company handle both soft and hard (sulphite) tissue both from virgin and recycled pulp. However the bulk of production is soft tissue.

5.2.1. The Site

The company have been at the site for some years. They have recently had a new production unit built. This has virtually doubled the total size of the premises. The old unit is now used exclusively for warehousing and office accommodation. The new unit is constructed from brick and steel under a pitched roof. The approximate dimensions are 52m x 107m x 7m to the eves and 11m to the apex. The unit comprises an open plan workroom with an integral service block comprising of canteen, washrooms etc. Being virtually new these are in a very good state of cleanliness and repair. Approximately 15% of the roof is lights. This coupled with numerous supplementary artificial lights suspended from the roof gives the large workroom a potentially very pleasant working environment. Sadly no thought was given to the companies specific ventilation requirements when the building was designed and constructed, so at

present there is no introduced ventilation. However since the building was commissioned and the company took control this deficiency is being tackled.

5.2.2. The Process

Bulk rolls of tissue are converted into two distinct types of finished product, rolls of tissue and boxes of individual tissues. There are a variety of machines in use at any one time. The majority are production line based, but several are self contained. All but one reeler, seen in operation were, manually operated. Most subsequent operations (eg. slitting/sawing/banding) are automated. Packing is manual.

Roll Products - Production Line

To make a roll of hand towel or a toilet roll by production line the process is as follows. The first stage is a re-reeling machine. Bulk rolls of tissue are delivered to the machine by fork lift truck (FLT). A spindle is put through the centre then the roll lifted onto the machines feed point by means of hydraulic arms or a hoist. The web of paper is then fed through a series of rollers to a roll up point. Here an operator manually places a long (up to ~2m) cardboard roll into the machine and starts it. A preset length of tissue is then automatically wound from the feed onto this roll. The operator then removes the full roll, pushes it onto a conveyor and puts a new empty roll into the machine. The cycle is then repeated. The conveyor, which includes a number of sideways transfer points eventually delivers the long rolls to a circular saw which automatically saws the rolls to the desired length. The conveyor then passes the rolls to a packing station where they are either passed through a wrapping machine then manually packed into cases or manually packed directly into the cases. Typically one operator operates the re-reeler, one or two operators mind the line and three or four operators carry out packing. Four lines of this type, were in use on the day of the visit. The largest line was fed by two reelers.

Roll Products - Batch Machines

Some machines re-reel and slit to length all in one process. There is no conveyor attached to these machines. The reeler operator carries out the packing on a batch process while another reel is winding to size. One machine of this type was seen operating on the day of the visit.

Boxed Products - Production Line

To make a box of tissues by production line the process is as follows. The first machine takes tissue from a bulk roll, loaded as above, passes the web through a series of rollers, then cut and folds the tissue to the desired width. The cut lengths build up in a cradle. When a desired number are in the cradle the operator manually transfers them to a conveyor, which transfers them to a bander. This automatically glues a paper band round them to hold them together. The conveyor then transfers them to a saw, which automatically cuts them to length., then on to a manual packing station, where they are boxed up. There would be typically three folder operators and two to three packers. There are currently two lines of this type. Both of these lines were in use on the day of the visit, one producing hard tissues and the other soft tissues.

Boxed Products - Batch Machines

Some machines, particularly hand towel machines, fold and cut to length in one operation. Here there is no conveyor. The operator removes the folded and cut wads of tissues. Bands them manually and boxes them manually. There are currently three machines of this type. Two were in production on the day of the visit. One person operates each machine and there is one peripatetic helper.

5.2.3. Sources of Dust

The principle source of dust during production is the web of tissue passing at speed through the reelers rollers. Generally the softer the tissue the greater is the potential for dust generation. Additionally the faster the web runs the more dust is generated. The Tyndall beam effect was used to verify this. The saws/slitters are also a potential source of dust, however, subjectively, to a lesser degree.

One operator was seen to clean his machine down with an airline. This only lasts for a few seconds so exposures could not be sampled individually by the sampling technique used on the survey.

Dust is not allowed to build up throughout the day. Operators clean up as they go using wide brooms to dry sweep. A few minutes at the end of each day is put aside for a final clean up, again by dry sweeping. All sweeping seen was carried out carefully and methodically. Once on surfaces the dust tends to form an agglomerate. Subjectively this did not appear to raise significant quantities of dust during sweeping. Sweeping was only carried out for a few minutes at a time, so exposures could not be sampled individually by the sampling technique used on the survey.

Waste is compacted before disposal in an in-house compactor situated in a corner of the workroom. Anecdotal evidence from the operators says that this is a dusty process. However the machine was only used for short periods during the visit and no sampling was carried out.

Roll Products - Production Line

The reelers feeding the production lines (m/c's 7.8.9.10) generally run at 300 m/min but can and do run at up to 470 m/min Dust is generated as the web passes through and around the various rollers. No 10 is automated and has a partial enclosure (open topped) hence the operator is segregated from direct exposure to this dust source. No 9 (has a guard which falls into place as the final roll is wound hense the operator is partially segregated from this dust source, however this segregation is a safety control measure and may well be ineffective in reducing dust exposure. At No 8 the reeler is open but the operator tends to stand away as the final roll is being wound, returning to the machine after the winding cycle has finished. No 7 Is of a slightly different design. The operator position is between the feed and take off rollers with the web passing overhead, thus forming a partial enclosed space in which dust generated from the web can be easily trapped. This potentially exposes the operator to higher concentrations of dust than machines at which the operator stands at one end. No 5 is an older machine. The

operator stands close to the open take off roll. By the end of the day there was a significant buildup of dust beneath the reelers, particularly reeler 7.

The saws/slitters are enclosed for safety reasons, some with mesh enclosures. The saws should not be a major source of dust.

Roll Products - Batch Machines

No 2 is a combined reeler/slitter. Dust is generated as the web passes through and around the various rollers. The operator position is at the take off end. The operator does not tend to stand close to the final roll when it is in motion as he is packing the previous batch at this time. This operator blows dust off using an air line between each batch (~ every 5-10 mins).

Boxed Products - Production Line

The folder/cutter (DCM) operators stand close to their machines at all times however the rolls turn relatively slowly so the potential for dust generation and exposure is much lower than for roll products. There are no controls on any of the machines.

Boxed Products - Batch Machines

Operators stand close to these machines. The rolls turn relatively slowly and hard tissue was being worked on the day of the visit. The potential for dust generation and exposure is subjectively, relatively, low.

5.2.4. Controls

There is no local exhaust ventilation installed on the processes described

There is no introduced general ventilation in the workroom, although the introduction is planned. Smoke tube tests showed that there was some air movement in all areas tested. At various times over the working day a dust haze was noticeable throughout the factory, but was particularly noticeable at high level at the end housing machines 9 & 10. The sampling team did not feel particularly uncomfortable when working in that area. This haze did disperse from time to time.

5.2.5. Protective Workwear

Safety boots/shoes and hearing protection are compulsory. Overalls and tabards are supplied but not universally worn. The survey team was told that Filtering Face Piece (FFP) respiratory protection was available but none was seen in use on the day of the visit.

5.2.6. Training

There is no specific health and safety training other than "on the job" training. There are worker safety representatives, but these are nonunion.

5.2.7. Results

Results and Operator 8-hr time weighted average exposures (8-hr TWA) are detailed in appendix 2 and summarized below.

1. Personal exposures to total inhalable particulate (TIP) were between 1.7 & 18.3 mg/m^3 8 hour time weighted average (8-hr TWA)

2. Re-reeler operators received the highest exposures of between 7.9 & 18.3 mg/m^3 (8-hr TWA). 3 of 5 exposures were above the COSHH limit of 10 mg/m^3 (8-hr TWA). All other operators had exposures below this limit.

3. A set of parallel static samplers for TIP and respirable dust indicated that the respirable fraction of the TIP is approximately 14%. If it is assumed that this figure is valid for personal samples all exposures to respirable dust in this factory would be well below the COSHH limit of 4 mg/m^3 (8-hr TWA). This would support the supposition that respirable dust exposure is less of a problem than TIP in this industry

5.3. Company 3

This company is one of the UK's leading independent manufacturers of disposable janitorial, catering and automotive products. The company buy in and convert bulk rolls of tissue, of various grades into a variety of products including, toilet rolls, toilet tissues, hand towels, and specialized wipes. There are two toilet roll making machines, which often convert a particularly soft grade of tissue. The machines are 5 - 10 years old. Production is approximately 5.000 tonnes per year. They employ a total of around 160. 3 crews work a three 8 hr shift system. Shifts include a total of 60 minutes breaks, usually taken in the works. There are about 90 exposed workers with 20 being considered directly exposed (6-7 per shift).

5.3.1. The Site

The buildings are modern and very spacious. The conversion hall is approximately 50m x 60m and open plan. It is constructed from brick and steel under a pitched roof. There is a smooth suspended ceiling. The buildings are in a very good state of cleanliness and repair. Lighting is entirely artificial but very good and the large well heated and ventilated workrooms potentially have a very pleasant working environment. The temperature varied through the day between 15°C and 21°C and Relative Humidity between 28 and 51%.

5.3.2. The Process

There are currently 14 conversion lines. Bulk rolls are delivered to winders by fork lift truck (FLT). They are then manually loaded onto the unwind roller using a hoist.

On the two toilet roll lines the winder converts the bulk roll to a toilet roll sized "log", which is then automatically ejected and transferred by conveyor and accumulator to a "log saw" which cuts the rolls to length, then they are conveyed on to packaging machines and in turn to

a palleting area where they are made ready for dispatch. These winders run at different speeds according to type and grade of tissue. Winder 1 typically runs at 900 m/min and winder 2 at 400 m/min. Up to three men run a roll conversion line.

Boxed tissue lines consist of an unwind roll, folder, saw and packing operations. These run at much slower speeds (70 - 150 m/min) and do not have the dust generating potential of faster machines.

There is one large multiple reeler/folder which converts a series of medium sized rolls to boxed facial tissues. Individual rolls on this machine also run slowly.

5.3.3. *Sources of dust*

The principle source of dust during production is the web of tissue passing at speed through the winders rollers. Generally the softer the tissue the greater is the potential for dust generation. Additionally the faster the web runs the more dust is generated. The Tyndall beam effect was used to verify this. The log saws are also a potential source of dust, however, subjectively, to a lesser degree. On line 1 (manufacturing the softest grade of tissue) there was a noticeable build up of dust around the rewind machines despite the use of LEV. All the other lines subjectively generated less dust.

Although line 1 log changing operation is automated the operator has to load the core hopper manually. Machine 2 has manual core change.

The web may break during rewinding operations. Here the machines are stopped to allow re-threading. Operators were seen to disturb laying dust at these times creating dust clouds around them.

5.3.4. *Cleaning*

Blowing down is prohibited at this site during normal production. Operators use vacuum cleaners periodically at all stages of production to clean off accumulations of dust from paper making machines, winders, conveyors and floors. Brushes are also used from time to time to clean floors. Brushing does generate dust clouds but these are subjectively much less than if air lines were used for the same task.

The machines are routinely cleaned down towards the end of each shift. This can take up to half an hour. Operators were seen to use vacuum cleaners to clean some surfaces and brooms and scrapers for others and floors. The resulting piles of dust are shoveled into bins with liners. The liners are tied off and transferred to skips for disposal, keeping dust generation to a minimum.

Complete blow-downs of the production lines are undertaken on Saturday mornings during quiet hours. Filtering face-piece RPE is used for this operation.

5.3.5. Engineering Controls

Winder 1 is fitted with slot exhaust above the first and last rollers. It is a dedicated system and terminates in a self cleaning filter tower bag filter. This is cleared daily. The LEV is maintained to a COSHH schedule. A consultant was used to provide a specification for the system but the installation was carried out by in house engineers. Although the LEV is undoubtedly effective in reducing exposure the company have identified improvements that can be made and are planning to extend the LEV to below the centre rollers. There are also plans to extend the system to include winder 2. An occupational hygiene consultant carried out air monitoring exercises before and after the installation of the LEV to assess the efficiency. The results are tabulated below in table 2

Table 2

Job	Inhalable dust mg/m³ before LEV	Inhalable dust mg/m³ after LEV	Respirable dust mg/m³ before LEV	Respirable dust mg/m³ after LEV
Operator	18.6	2.4	0.36	0.21
Operator	4.62	-	0.25	-
Packing	12.26	-	4.97	0.02
Packing	3.25	-	1.3	-
Static by No 1	9.2	1.3	3.05	-

At the first roll capture velocity was measured at 0.8 - 1.0 m/s on the web in side and 0.4 - 0.6m/s at the web out side. Face velocity along the slot was 3 - 5 m/s. At the last roll capture velocity was measured at 0.6 - 0.8 m/s on the web in side and 0.6 - 0.8 m/s at the web out side. Face velocity along the slot was 0.8 - 1.3 m/s. It was difficult to reach the extraction at the time of the visit and these measurements should be treated with caution. Smoke was effectively captured by the LEV. The Tyndall beam, however, showed capture to be only partially effective, particularly on the web out side. The speed of the web was negating some of the effectiveness of the ventilation. It is understood that the LEV is variable and was not working to capacity at the time of the visit. The LEV fan is interlocked with the winder so as to cut off the suction as the web slows down. this effectively avoids the stationary web being sucked into the inlets.

Log saws are enclosed for safety and extracted to remove roll ends, swarf, etc. This effectively controls dust generation during normal production.

There is no other extraction fitted.

Most other stages of production have safety enclosures.

5.3.6. General Ventilation

There is an introduced general ventilation system. Extraction is in the ceiling with low level inlet vents in the walls . This is primarily to control temperature but does introduce air movement which was verified using a smoke generator. This system may be more effective controlling dust if the flow was reversed. The workrooms are very spacious, which allows some dilution of the dust cloud. The sampling team did not feel particularly uncomfortable when working in the. area.

5.3.7. Respiratory protection

Filtering face-piece respirators are available, but use is not compulsory. They were seen to be used by most operators during cleaning down

5.3.8. Protective Workwear

Uniforms are worn and there is regular in house laundry. Safety boots/shoes and hearing protection are compulsory. Goggles are also available but were not seen to be used.

5.3.9. Training

There is health and safety induction and a rolling H&S training programme mostly in house.

The company consider by far the major H&S hazard from tissue dust is fire. However, they are aware of potential risks to health. As described above, in house exposure assessments have been carried out, including personal air monitoring programs.

5.3.10. Results

Results and Operator 8-hr time weighted average exposures (8-hr TWA) are detailed in appendix 1 and summarised below.

1. The personal exposure of rewind 1 operator to total inhalable particulate (TIP) was 10.1 mg/m^3 8 hour time weighted average (8-hr TWA). The COSHH limit of 10.0 mg/m^3 8 hour (8-hr TWA) is appropriate for tissue dust.

2. Personal exposures of other operators to total inhalable particulate (TIP) were between 1.0 and 3.6 mg/m^3 8 hour time weighted average (8-hr TWA).

3. The use of compressed air lines for cleaning down is banned during normal production time. Clean downs are carried out by operators at the end of shifts using brushes and vacuum cleaners. This lasts for 20 - 30 minutes and produced operator personal exposures of between 11.9 & 14.3 mg/m^3 Complete blow-downs of the production lines are undertaken on Saturday mornings. Filtering face-piece RPE is used for this operation.

4. A static sampler for TIP sited on the control panel of machine 1 gave a value of 6.5 mg/m^3. This sampler was close to the machine, a significant source of dust. A parallel sampler for respirable dust recorded a level of 0.24 mg/m^3. The percentage respirable dust was therefore 3.8%. This would indicate that respirable dust is unlikely to be a problem at this site. Respirable dust sampling by independent consultants would appear to support this.

5.4. Company 4

At this site bulk rolls of tissue are converted into toilet rolls on up to 8 machines in three conversion halls. Production is approximately 80.000 tonnes per year. They employ a total of around 100 operators. 5 crews work a three shift system, 07:00 - 14:00, 14:00 - 22:00, and 22:00 - 07:00. Shifts include a total of 60 minutes breaks, usually taken in the works canteen. The company manufacture a "premier" quality soft tissue together with a number of super-market "own label" quality products. However the bulk of production is very soft tissue.

5.4.1. The Site

Tissue has been made at the site for many years, but has only been owned by the present company since relatively recently. The site is large. The buildings are modern and spacious and mostly constructed from brick and steel under a pitched roof. They are in a very good state of cleanliness and repair. Lighting is good and the large workrooms potentially have a very pleasant working environment.

5.4.2. The process

There are 8 conversion lines located in three halls. Bulk rolls are delivered to winders by fork lift truck (FLT). They are then manually loaded onto the unwind roller using a hoist. The winder converts the bulk roll to a toilet roll sized "log", which is then automatically ejected and transferred by conveyor (and sometimes an accumulator) to a "log saw" which cuts the rolls to length, then they are conveyed on to packaging machines and in turn to a palleting area where they are made ready for dispatch. Conversion winders run at different speeds according to type and grade of tissue. Machines 1-3, 5, 7 &12 typically run at 150 - 300 m/min and Machines 10 & 11 typically run at 500 - 550 m/min. Usually three men run a conversion line.

5.4.3. Sources of dust

The principle source of dust during production is the web of tissue passing at speed through the winders rollers. Generally the softer the tissue the greater is the potential for dust generation. Additionally the faster the web runs the more dust is generated. The Tyndall beam effect was used to verify this. The log saws are also a potential source of dust, however, subjectively, to a lesser degree. On the lines manufacturing the softest grade of tissue there was also a significant build up of dust around bagging machinery etc.

The web may break during rewinding operations. Here the machines are stopped to allow re-threading. Operators were seen to disturb laying dust at these times creating dust clouds around them.

5.4.4. Cleaning

Operators use air lines periodically at all stages of production to clean off accumulations of dust from winders, conveyors and floors. Substantial dust clouds are generated at these times, which can last from a few minutes to several hours for a major clean down.

The winders are routinely blown down at the end of each shift. This can also take up to half an hour.

A team of contract cleaners are employed full time to keep the floors clean. They use a combination of ride on vacuum cleaners, manual vacuum cleaners and brushing.

5.4.5. Controls

There is no local exhaust ventilation installed on the conversion machines.

Log core and roll changes are automated so operators to not need to spend time in these areas, which is a major source of dust.

Machines 10 & 11 have partial enclosures, primarily a noise reduction measure. However these enclosures will offer some protection to operators from dust during normal production and so reduce overall exposure.

Other winders have guarding, usually mesh. These serve to distance operators from the primary source of dust and so reduce their overall exposure.

Log saws are enclosed for safety and extracted to remove roll ends, swarf, etc. This effectively controls dust generation during normal production.

Most other stages of production have safety enclosures.

There is no introduced general ventilation in any of the conversion halls. The workrooms are very spacious, which allows some dilution of the dust cloud. Smoke tube tests showed that there was some air movement in all areas tested. At various times over the working day a dust haze was noticeable throughout the premises. However the sampling team did not feel particularly uncomfortable when working in these areas. This haze did disperse from time to time.

5.4.6. Respiratory protection

Filtering face-piece respirators are available, but use is not compulsory. They were seen to be used by most operators during blowing down

5.4.7. Protective Workwear

Uniforms are worn and there is regular in house laundry. Safety boots/shoes and hearing protection are compulsory, as are goggles when blowing down. Disposable coveralls are also available.

5.4.8. Training

There is health and safety induction and a rolling H&S training programme mostly in house.

The company consider by far the major H&S hazard from tissue dust is fire. However, they are aware of potential risks to health. In house exposure assessments have been carried out, including personal air monitoring programs. They have a resident nurse and a doctor.

5.4.9. Results

Results and Operator 8-hr time weighted average exposures (8-hr TWA) are detailed in appendix 1 and summarized below.

1. In the tissue conversion halls personal exposures of rewind machine operators to total inhalable particulate (TIP) were between 4.0 & 14.0 mg/m^3 8 hour time weighted average (8-hr TWA).

2. In the tissue conversion halls the personal exposure of a peripatetic contract cleaner to total inhalable particulate (TIP) was 1.5 mg/m^3 8 hour time weighted average (8-hr TWA). This would be a good indication of the expected exposures of other workers in the area such as packers.

3. A static sampler for TIP sited on the control panel of the rewind machine 11 gave a value of 22.6 mg/m^3. This sampler was close to the machine, a significant source of dust. A parallel sampler for respirable dust recorded a level of 6.3 mg/m^3. The percentage respirable dust was therefore 28%.

4. The wide range of exposures for operators carrying out essentially similar tasks on similar products (from approx. 0.5 to approx.1.5 times the COSHH limit) is probably explained by differences in time spent on maintenance and blowing down. This will vary from day to day.

5.5. Company 5

There has been a tissue conversion facility on the site for many years, but has only been in the ownership of this company since relatively recently. There have been significant increases in productivity made, which is still being implemented. This has resulted in a dramatic reduction in manpower levels. They currently employ a total of 180 in the conversion facilities. 5 crews work a 2 x 12 hour shift system. Shifts include a total of about 60 minutes breaks, usually taken in the works canteens. There are two separate conversion halls. The company manufacture a premier quality extra soft tissue.

5.5.1. The Site

The large complex of buildings are modern and spacious and mostly constructed from brick and steel under a pitched roof. They are in a very good state of cleanliness and repair. Lighting is adequate and the large workrooms potentially have a pleasant working environment. There are two conversion halls. The smaller of the conversion facilities is due to close in the near future.

5.5.2. The process

There are currently 5 working conversion lines located in three halls (one bagging and packing facilities only). In hall 1 three large machines convert the 133 inch wide bulk rolls. Bulk rolls are delivered to winders by ATV. They are then manually loaded onto the unwind rollers using a hoist. The winders double the web and converts the resulting 2 ply bulk roll to a toilet roll sized "log", which is then automatically ejected and transferred by conveyor and an accumulator to a "log saw" which cuts the rolls to length. The rolls are then conveyed on to a segregated room containing a variety of bagging and packaging machines and in turn to a palleting area where they are made ready for dispatch. Much of the bagging packing and palleting is carried out automatically. Conversion winders run at different speeds according to type and grade of tissue. Machines typically run at 670 m/min. One operator runs a conversion line. There are peripatetic helpers to cover during breaks etc. There are two smaller conversion machines in hall 2.

5.5.3. Sources of dust

The principle source of dust during production is the web of tissue passing at speed through the winders rollers. Generally the softer the tissue the greater is the potential for dust generation. Additionally the faster the web runs the more dust is generated. The Tyndall beam effect was used to verify this. The log saws are also a potential source of dust, however, subjectively, to a lesser degree.

The web may break during rewinding operations. Here the machines are stopped to allow re-threading. Operators have to enter the machines for this operation and are likely to disturb accumulated dust raising a secondary dust cloud.

5.5.4. Cleaning

The winders are routinely blown down once a shift and at colour changes. This can also take up to half an hour. Other blowing down is restricted to activities essential to maintain production. Once the blown dust is on the floor it is swept up with brushes or vacuumed. Vacuum cleaning is used for intricate areas such as switchboxes.

Major clean-downs with air are carried out by contractors. None were seen during the visit.

5.5.5. Controls

The 3 largest winders have extracted enclosures and these winders are fitted with comprehensive LEV. The unwind rolls have extractors above, which raise and lower to allow access. These were not always used. There is also LEV above and below the log roll and tail tier. Additionally there is a door at the log roll which can be raised and lowered to allow maintenance. This door was not always lowered during production, probably leading to reduced effectiveness. There is also elephant trunking extracting from strategic points below the web.

Log core and roll changes are automated so operators to not need to spend time in these areas, which is a major source of dust.

Log rolls pass to an accumulator, then on to an enclosed, extracted, log saw. They are then conveyed through a wall to a segregated packing area. This area was not included in the survey.

The two smaller winders were fitted with comprehensive LEV systems above and below the web at each of the rollers. Some of the slots were visibly blocked on the day of the visit.

There are numerous vacuum cleaner attachment points in the LEV trunking for the use of operators. However the operators said this system was inefficient and was easily blocked.

There is no supplied air dilution ventilation in the conversion halls. Smoke tube test confirmed air movement to be present.

5.5.6. Respiratory protection

Filtering face-piece respirators are available, and use compulsory for blowing down. They were seen to be used by most operators during blowing down

5.5.7. Protective Workwear

Overalls are worn and there is regular in house laundry. Safety boots/shoes and hearing protection are compulsory, as are goggles when blowing down. Disposable coveralls are also available.

5.5.8. Training

There is health and safety induction and a rolling H&S training programme mostly in house, IOSH based. There are safety and PPE manuals available. A safety manual was seen beside the canteen entrance. The company work to HSG65 requirements.

5.5.9. Results

Results and Operator 8-hr time weighted average exposures (8-hr TWA) are detailed in appendix 1 and summarized below.

1. In the first tissue conversion hall personal exposures of rewind machine operators to total inhalable particulate (TIP) were between 10.9 & 28 mg/m^3 with 8 hour time weighted averages (8-hr TWA) being between 16.35 & 40.5 mg/m^3 due to the 12 hour shifts.

2. In the second tissue conversion hall personal exposures of rewind machine operators to total inhalable particulate (TIP) were between 8.3 & 13 mg/m^3 with 8

hour time weighted averages (8-hr TWA) being between 18.1 & 33.4 mg/m^3 due to the 12 hour shifts and a period of blowing down.

3. Operators blow down parts of their machines with compressed air from time to time during normal production. This activity may last for a minute or two. Dense dust clouds were seen to be raised during this activity. However due to good ventilation the dust clouds soon dispersed. Compressed airlines are used to thoroughly clean the machines once a shift. This was not seen in the first conversion hall, however a complete blow-down of two machines was undertaken towards the end of the shift in the second conversion hall. This produced operator personal exposures of between 97 & 235 mg/m^3. This task took approximately 30 minutes. The measured levels are potential exposure and do not take into account the effectiveness of any respiratory protective equipment that may have been worn while carrying out the work.

4. A static sampler for TIP sited in the log wind area of the two machines in the second conversion hall gave a value of 4.3 mg/m^3. A parallel sampler for respirable dust was spoiled during analysis, but could not have been greater than 2.6 mg/m^3. The percentage respirable dust was therefore less than 60%. This is figure is significantly higher than average and should be treated with caution. Visibly the filter was very lightly loaded and the percentage respirable dust is likely to be much lower than 60%.

6. CONVERSION RESULTS - SUMMARY

6.1. Rewind Operators

The minimum, maximum, median and 95%ile operator exposures for winder operators are shown below in table 3.

Table 3

	Exposure No Ventilation mg/m3	8hr TWA No Ventilation mg/m3	Exposure With Ventilation mg/m3	8hr TWA With Ventilation mg/m3
n	16	16	8	8
Min	2.2	2.2	8.3	10.1
Max	18.3	18.3	27.9	40.5
Median	7.05	6.6	12.0	30.5
95%ile	16.6	15.1	27.6	39.3

6.2. Other Operators

The minimum, maximum, median and 95%ile operator exposures to TIP for other operators working in conversion facilities are shown below in table 4.

Table 4

	Exposure mg/m³ Rewind Line Workers	8-hr TWA mg/m³ Rewind Line Workers	Exposure mg/m³ Other Jobs (peripatetic)	8-hr TWA mg/m³ Other Jobs (peripatetic)	Exposure mg/m³ Folder Operators	8-hr TWA mg/m³ Folder Operators	Exposure mg/m³ Blowing Down	Exposure mg/m³ Sweeping Down
n	7	7	2	2	4	4	7	3
Min	1.7	1.7	0.6	0.6	1	1	6.4	11.9
Max	3.1	3.3	1.7	1.7	6.4	6.4	235	19.5
Median	2.4	2.5	1.2	1.1	3.6	3.6	28	14.3
95%ile	3.0	3.2	1.6	1.5	6.3	6.3	228	18.9

Table 4 clearly shows that most operators working in conversion facilities are unlikely to be exposed above the COSHH limit (0% of Other Workers >10mg/m³). However table 3 shows the situation is very different for winder operators. During the survey 46% of Rewind Operators were found to have exposures in excess of 10mg/m³. Table 3 also shows that the results are anomalous with regard to the use of LEV. The anomalies are even more dramatic when the results are listed by site (not necessarily in company order above).

Percentage of rewind operators exposed to > 10mg/m3 8hr TWA TIP

- Site 1 - 43%
- Site 2 - 50%
- Site 3 - 0% - LEV
- Site 4 - 0%
- Site 5 - 86% - LEV

It is clear that there are many factors that contribute to overall exposure and that the introduction of LEV in isolation is unlikely to control exposure below 10.0 mg/m³. LEV will contribute towards reducing exposure, but it needs to be integrated with other controls and dust conscious working practices.

7. DISCUSSION

7.1. General

The following points were found to be common to all sites visited.

1. All companies considered the major H&S hazard from tissue dust is fire.

2. All companies realized there were potential risks to operator health due to inhalation of excessive amounts of tissue dust and had policies in place to control exposure.

3. The amount of dust generated during tissue manufacture and conversion is dependent on many factors. These include:

- Type of pulp used (virgin pulp, more dust)
- Scale of production
- Softness of the tissue. (smaller particles, therefore dustier)
- Moisture content (less moisture, more dust generated)
- Amount of additives (wet strength additives reduce dust)
- Grammage (weight per unit area)
- Speed of rollers (faster speed, more dust)
- Level of expertise of the company paper maker.

4. Personal exposure is likely to vary widely from day to day, depending on the type of tissue being manufactured or converted. Undoubtedly the sites with the biggest dust exposure problems seen on this survey were those running the softest product.

5. 12 hour shifts are common.

7.2. Tissue Manufacture

1. Operator exposure to total inhalable particulate (TIP) was measured at 6 paper making machines.

2. Airborne dust was seen to be generated at all stages of the process between the removal of the web of dried tissue from the Yankee wheel by the doctor (creaping) blade and the final reel-up. There was a buildup of dust around the dry end of the machine through the shift with or without Local Exhaust Ventilation being installed

3. Blowing down with air lines was the method of cleaning down both the "dry end" of the paper making machines and the workroom at all sites visited.

4. In Tissue Manufacturing halls without LEV or dilution ventilation personal exposures to total inhalable particulate (TIP) were between 3.4 & 21 mg/m^3 during normal production however when allowance was made for periodic blowing down and 12 hour shifts 8 hour time weighted average (8-hr TWA) exposures were calculated as being between 8.9 & 34.4 mg/m^3. The COSHH limit of 10 mg/m^3 (8-hr TWA) is appropriate for inhalable paper tissue dust. These levels are potential exposures and do not take into account the effectiveness of any respiratory protective equipment that may have been worn. Where LEV or dilution ventilation had been introduced personal exposures to total inhalable particulate (TIP) were between 1.8 & 7.9 mg/m^3 during normal production however when allowance was made for periodic blowing down and 12 hour shifts 8 hour time weighted average (8-hr TWA) exposures were calculated as being between 3.0 & 19.5 mg/m^3.

5. The highest exposures were recorded for operators who included cleaning down with compressed air lines as part of their work pattern. Levels of between 14.5 & 251 mg/m^3 were measured during these short term activities. These levels are potential exposures and do not take into account the effectiveness of any respiratory protective equipment that may have been worn.

6. Personal exposure to respirable dust was not measured as part of this survey. However, pairs of static samplers strategically sited indicated that the respirable fraction of the TIP is likely to be well below 40%, indicating that if TIP is adequately controlled respirable dust will also be adequately controlled.

7.3. Conversion

1. Operator exposure to total inhalable particulate (TIP) was measured at 5 conversion facilities.

2. The major sources of dust were the rewind machines. A dust cloud was seen to be generated each time the web of paper passed across a roller. After several hours production dust was seen to have accumulated on, beneath, and around the machines if LEV had been installed or not.

3. Blowing down with air lines was the method of choice for cleaning down at most sites visited. However, one had banned the use of airlines for cleaning during normal production and another had restricted airline use to colour changes. The general belief was that machine clean-down by vacuuming was to slow, particularly in the larger establishments, and would take far to long. The places where vacuuming was used tended to be either small establishments or vacuuming only used for area cleaning by dedicated personnel. However, after the HSL visit, one larger site decided to experiment by taking the airlines out altogether in one area and only use vacuum cleaning and brushing down methods. It is understood that at first there was resistance from the operators, but after a while they accepted that the method was effective and has resulted in less frequent clean-downs, so the time factor is less of a problem than first thought.

Plans are in place to extend the experiments. This site has very large, powerful vacuum cleaners fit for the purpose. They receive regular cleaning and maintenance. Subjectively, many areas such as switchboxes are very awkward to access and it is encouraging that a prohibition of blowing down has been so readily accepted. Other sites had reported, serious, clogging problems with vacuum cleaners and believed the method to be impractical. Some other places obtained vacuum points from the extraction system. Operators tended to think that this method was not powerful enough to be effective. This supposition is probably correct as the extraction system is likely to be high volume low velocity therefore unsuitable for cleaning purposes.

4. Some sites used brooms or had scrapers for cleaning floors. Scrapers were effective in cleaning very even floors and subjectively raised little dust. Although no measurements were taken for this specific activity When sweeping with brooms short term operator exposures were measured at between 12 & 20 mg/m^3. Occasional, careful, short term sweeping up is not believed to be a major contributor to overall exposure.

5. Operators of rewind machines with LEV had personal exposures to total inhalable particulate (TIP) between 8.3 & 27.9 mg/m^3 during normal production however when allowance was made for periodic blowing down and 12 hour shifts 8 hour time weighted average (8-hr TWA) exposures were calculated as being between 10.1 & 40.5 mg/m^3. The COSHH limit of 10 mg/m^3 (8-hr TWA) is appropriate for inhalable paper tissue dust. These levels are potential exposures and do not take into account the effectiveness of any respiratory protective equipment that may have been worn. Where LEV or dilution ventilation had not been introduced personal exposures to total inhalable particulate (TIP) were between 2.2 & 18.3 mg/m^3 during normal production and even when allowance was made for periodic blowing down and 12 hour shifts 8 hour time weighted average (8-hr TWA) exposures were calculated as still being between 2.2 & 18.3 mg/m^3. These figures show that the introduction of LEV alone will not necessesserily effectively control exposure. The site where the extensive LEV was least effective in controlling personal exposures had the largest plant of all. Operators often have to do running maintenance due to web breaks etc. They get necessarily close to the source of emission and receive very large exposures at these times, which invariably defeats the LEV. The one day exposure assessments during the current exercise could not even begin analyzing these wildly fluctuating exposure patterns. However it was very interesting to note that the site with the most up to date plant recorded the lowest exposures. It may well be that this was because the plant was more reliable resulting in less of these maintenance excursions.

6. The highest exposures were recorded for operators who included cleaning down with compressed air lines as part of their work pattern. Levels of between 6.4 & 235 mg/m^3 were measured during these short term activities. These levels are potential exposures and do not take into account the effectiveness of any respiratory protective equipment that may have been worn.

7. Personal exposure to respirable dust was not measured as part of this survey. However, pairs of static samplers strategically sited indicated that the respirable fraction of the TIP is likely to be well below 40%, indicating that if TIP is adequately controlled respirable dust will also be adequately controlled..

8. The wide range of exposures for operators carrying out essentially similar tasks on similar products is probably explained by differences in scale of production and in time spent on maintenance. This will vary considerably from day to day.

9. No other operators in the conversion facilities visited had operator exposures in excess of 10mg/m^3 (8-hr TWA)

8. CONCLUSIONS

1. The use of airlines to blow down is the major contribution to overall exposure in this industry.

2. Vacuum cleaning and sweeping are practicable alternatives to cleaning down with airlines.

3. The use of air conditioned operator refuges is the most effective control measure during tissue manufacture.

4. Operator exposure in tissue manufacture can be further controlled by the introduction of LEV and/or dilution ventilation together with a robust RPE use policy for short term dust generating activities such as maintenance and cleaning down.

5. Operator exposure during conversion activities is generally well controlled, with the exception of operators of high speed winders (i.e.>400m/min)

6. Control of exposure during high speed rewinding is not straightforward. The introduction of LEV will not necessarily control overall exposure. In extreme cases the introduction of LEV and the use of an extracted enclosure may not effectively control overall exposure. In these extreme cases there may be no viable alternative to the use of RPE for all tasks except basic machine minding.

7. Blowing down remains the most significant source of exposure 30mins at 200 mg/m3 is equivalent to 12.5 mg/m3 for 8 hour.

9. PRACTICAL SOLUTIONS

The following list of control measures are practicable and have been demonstrated to contribute to a reduction operator exposure.

9.1. Manufacture

1. Provision of air conditioned refuges.

2. Compulsory use of RPE for reel changes, paper breaks, & blowing down.

3. Planned blow-downs

4. Only blow down where absolutely necessary (i.e. overhead ledges) swill down or use vacuum cleaners once the dust is on the floor (we believe there is sufficient operator slack time to do this).

5. Introduction of dilution ventilation

6. Installation of LEV to all rollers from doctor blade onwards

7. Water Curtains below web after doctor blade

9.2. Conversion

1. Segregation of winders

2. Good dilution ventilation

3. Eliminate or minimise blowing down with airlines.

4. Elimination of blowing down during production runs

5. Use vacuum cleaners where practical (i.e. floors)

6. Install LEV above and below the web at all rollers on winders, particularly those running in excess of 400 m/min.

7. Regular thorough maintenance of LEV

8. Strategic compulsory use of RPE (Reel change, maintenance, etc).

9. Use paper threading belts to minimize entry to machines

APPENDIX 1 - RESULTS MANUFACTURE

HEALTH & SAFETY LABORATORY

Environmental monitoring Data

BOHS British Occupational Hygiene Society

Author R Guiver
Tel No. 0114 289 2713

File reference FS/RE/32/2000	Reference to related records	Date of sampling	Total no of people on site 20		Agent		Inhalable Dust		Respirable Dust			
Occupier of premises	**Manufacturing Company 1**				CAS No.							
Address of premises/Location/Identity					Units		mg/m³		mg/m³			
					Sampling/Analysis Details							
		Post Code			MSDS Ref		14/3		14/3			
Department/Area Mill					Males exposed		90		90			
Building/Room Mill					Females exposed		included above		included above			

Reference Number	Sample type	Sample description (eg name/task/process/equipment	Male Female	NI no. Personal no.	Sample period	Duration (Mins)	Result	TWA	Result	TWA	Result	TWA
HSL/00766/01	PL	Mill, Dryer Man	M		06 23-07 17 & 07 34-11 02	262	3.6	n/a	-	-		
HSL/00767/01	PL	Mill, Dryer Man, Blowing Down	M		07:18 - 07:33	15	92	n/a	-	-		
	CM	Mill, Dryer Man	M		8 hr shift			7.1	-	-		
HSL/00769/01	PL	Mill, Dryer Man 2	M		06 25-07 17 & 07 33-11 02	261	5	n/a	-	-		
HSL/00770/01	PL	Mill, Dryer Man 2, Blowing Down	M		07:19 - 07:32	13	49	n/a	-	-		
	CM	Mill, Dryer Man 2	M		8 hr shift		-	6.4	-	-		
HSL/00768/01	PL	Mill, Fork Lift Trainee	M		06:24 - 11:00	276	3	3	-	-		
HSL/00771/01	PL	Mill, Machine Man	M		06:30 - 11:00	270	3.8	3.8	-	-		
HSL/00772/01	SL	Static on reel change control panel			06:37 - 11:06	269	9.8	n/a	-	-		
HSL/00773/01	SL	Static on reel change control panel			06:37 - 11:06	269	-	-	Sample spoiled but 1.9 max			
Exposure limits			LTEL (8 Hour TWA)				10		4			
			STEL (15 minute)				-		-			

Industry and SIC Code PAPER AND BOARD						Comments on origin of sampled material e.g. product name
Reason for monitoring INFORMATION GATHERING						
Biological monitoring NO						
Exposure details			Control measures		Related records	
Conditions	Frequency	Metabolic rate	RPE	LEV		
N	C	MP	N	N		
N	I	MP	Y	N		Comments on exposure modifiers, e.g. skin contact, other relevant jobs, confounding factors, biological monitoring
N	C	MP	N	N		
N	I	MP	Y	N		
N	C	MP	N	N		
N	C	MP	N	N		

HEALTH & SAFETY LABORATORY

Environmental monitoring Data

BOHS British Occupational Hygiene Society

Author R Guiver

Tel No. 0114 289 2713

File reference FS/RF/32/2000	Reference to related records	Date of sampling	Total no of people on site 66	Agent		Inhalable Dust					
Occupier of premises **Manufacturing Company 2**				CAS No.							
Address of premises/Location/Identity				Units		mg/m³					
				Sampling/Analysis Details							
		Post Code		MSDS Ref		14/3					
Department/Area Manufacturing Mill				Males exposed		25					
Building/Room Machine House Beloit m/c				Females exposed		unknown					

Reference Number	Sample type	Sample description (eg name/task/process/equipment	Male Female	NI no. Personal no.	Sample period	Duration (Mins)	Result	TWA	Result	TWA	Result	TWA
	PL	Team Leader	M		13:01 - 15:01	120	3.9	n/a				
	PL	Team Leader, working during blowdown	M		15:01 - 15:53	52	10.5	n/a				
	PL	Team Leader, working after blowdown	M		15:53 - 17:40	107	6.4	n/a				
	CM	Team Leader	M		12 hr shift	-	n/a	7.2				
	PL	Machine Operator	M		13:03 - 14:58	115	8.3	n/a				
	PL	Machine Operator, major blowdown	M		15:04 - 15:50	46	251	n/a				
	PL	Machine Operator, after major blowdown	M		15:55 - 17:40	105	5.3	n/a				
	CM	Machine Operator	M		12 hr shift	-	n/a	34.27				
Exposure limits			LTEL (8 Hour TWA)				10					
			STEL (15 minute)				-					

Industry and SIC Code PAPER AND BOARD

Reason for monitoring INFORMATION GATHERING

Biological monitoring NO

Exposure details			Control measures		Related records
Conditions	Frequency	Metabolic rate	RPE	LEV	
N	C	MP	Y	N	
N	I	MP	Y	N	
N	C	MP	Y	N	
N	C	MP	Y	N	
N	I	MP	Y	N	
N	C	MP	Y	N	

Comments on origin of sampled material e.g. product name

Comments on exposure modifiers, e.g. skin contact, other relevant jobs, confounding factors, biological monitoring

HEALTH & SAFETY LABORATORY

Environmental monitoring Data

BOHS British Occupational Hygiene Society

Author R Guiver

Tel No. 0114 289 2713

File reference FS/RE/32/2000	Reference to related records	Date of sampling	Total no of people on site 66	Agent		Inhalable Dust	Respirable Dust	
Occupier of premises **Manufacturing Company 2**				CAS No.				
Address of premises/Location/Identity				Units		mg/m³	mg/m³	
				Sampling/Analysis Details				
		Post Code		MSDS Ref		14/3	14/3	
Department/Area Manufacturing Mill				Males exposed		25	25	
Building/Room Machine House (Beloit m/c)				Females exposed		unknown	unknown	

Reference Number	Sample type	Sample description (eg name/task/process/equipment	Male Female	NI no. Personal no.	Sample period	Duration (Mins)	Result	TWA	Result	TWA	Result	TWA
	PL	Technical Assistant Operator	M		13:05 - 15:10	125	9.2	n/a	-	-		
	PL	Technical Assistant Operator, working during blowdown	M		15:10 - 15:55	45	12.7	n/a	-	-		
	PL	Technical Assistant Operator, working after blowdown	M		15:55 - 17:40	105	5.8	n/a	-	-		
	CM	Technical Assistant Operator	M		12 hr shift	-	n/a	8.9	-	-		
	SL	Static on reel change control panel	-		14:03 - 16:27	144	20.1	n/a	-	-		
	SL	Static on reel change control panel	-		14:03 - 16:27	144	-	-	0.26	n/a		
Exposure limits			LTEL (8 Hour TWA)				10		4			
			STEL (15 minute)				-		-			

Industry and SIC Code PAPER AND BOARD

Comments on origin of sampled material e.g. product name

Reason for monitoring INFORMATION GATHERING

Biological monitoring NO

Exposure details			Control measures		Related records
Conditions	Frequency	Metabolic rate	RPE	LEV	
N	C	MP	Y	N	
N	I	MP	Y	N	
N	C	MP	Y	N	

Comments on exposure modifiers, e.g. skin contact, other relevant jobs, confounding factors, biological monitoring

HEALTH & SAFETY LABORATORY

Environmental monitoring Data

BOHS British Occupational Hygiene Society

Author R Guiver
Tel No. 0114 289 2713

File reference FS/RE/32/2000	Reference to related records	Date of sampling	Total no of people on site 60	Agent		Inhalable Dust		Respirable Dust			
Occupier of premises **Manufacturing Company 3**				CAS No.							
Address of premises/Location/Identity Prudhoe Mill, Princess Way, Prudhoe, Northumberland.				Units		mg/m³		mg/m³			
				Sampling/Analysis Details							
		Post Code		MSDS Ref		14/3		14/3			
Department/Area				Males exposed		160		160			
Building/Room Machine House				Females exposed		unknown		unknown			

Reference Number	Sample type	Sample description (eg name/task/process/equipment	Male Female	NI no. Personal no.	Sample period	Duration (Mins)	Result	TWA	Result	TWA	Result	TWA
HSL/00046/01	PL	Console Operator, P2, Normal Operation	M		07:24 - 12:06	282	4.43	3.9	-	-		
HSL/00047/01	PL	Winders Assistant, P2, (including a blowdown)	M		07:25 - 12:35	310	8	7	-	-		
HSL/00048/01	PL	Machine Man, Blowdown P2	M		11:50 - 12:06	16	74	n/a	-	-		
HSL/00042/01	PL	Console operator, No1, normal running	M		07:15 - 11:43	268	3.4	n/a	-	-		
HSL/00043/01	PL	Console operator, No1, major blowdown	M		11:43 - 12:34	51	100	n/a	-	-		
	CM	Console Operator, No 1	M		-	-	-	15	-	-		
HSL/00044/01	PL	Winder assistant, No 1, normal running	M		07:20 - 09:02	102	3.5	n/a	-	-		
HSL/00045/01	PL	Winder assistant, No1, including blowdown	M		11:45 - 13:25	100	21	n/a	-	-		
	CM	Winder assistant No1	M		-	-	-	7.5	-	-		
HSL/00054/01 & HSL/00055/01	SL	Static Beside Machine 2	-		08:30 - 13:25	295	6.7	na	Sample lost	n/a		
HSL/00055/01			LTEL (8 Hour TWA)				10		4			
			STEL (15 minute)				-		-			

Industry and SIC Code PAPER AND BOARD					Comments on origin of sampled material e.g. product name
Reason for monitoring INFORMATION GATHERING					
Biological monitoring NO					
Exposure details			Control measures		Related records
Conditions	Frequency	Metabolic rate	RPE	LEV	
N	C	LP	N	N	
N	C	LP	N	N	Comments on exposure modifiers, e.g. skin contact, other relevant jobs, confounding factors, biological monitoring
N	C	LP	N	N	
N	C	LP	N	N	
N	I	HP	Y	N	
N	C	LP	N	N	
N	I	MP	N	N	
N					

HEALTH & SAFETY LABORATORY

Environmental monitoring Data

BOHS British Occupational Hygiene Society

Author **R Guiver**
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File reference FS/RE/32/2000	Reference to related records	Date of sampling	Total no of people on site 60	Agent		Inhalable Dust	Respirable Dust	
Occupier of premises **Manufacturing Company 4**				CAS No.				
Address of premises/Location/Identity				Units		mg/m³	mg/m³	
				Sampling/Analysis Details				
		Post Code		MSDS Ref		14/3	14/3	
Department/Area Mill				Males exposed		75	75	
Building/Room No3 Mill				Females exposed		unknown	unknown	

Reference Number	Sample type	Sample description (eg name/task/process/equipment	Male Female	NI no. Personal no.	Sample period	Duration (Mins)	Result	TWA	Result	TWA	Result	TWA
HSL/00840/01	PL	Paper machine 3, operator	M		08:10 - 12:20	230	7.9	n/a	-	-		
HSL/00836/01	PS	Paper machine 3, operator, blow down top of machine	M		06:55 - 07:27	32	123	n/a	-	-		
HSL/00838/01	PS	Paper machine 3, operator, blow down floor	M		07:28 - 08:10	42	14.4	n/a	-	-		
	CM	Paper machine 3, operator	M		12 hr shift	-	-	19.5	-	-		
HSL/00839/01	PL	Paper machine 3, operator maintainer	M		07:25 - 11:28	31	1.8	n/a	-	-		
HSL/00837/01	PS	Paper machine 3, operator maintainer, blow down around m/c	M		06:56 - 07:27	243	48	n/a	-	-		
	CM	Paper machine 3, operator maintainer	M		12 hr shift	-	-	5.6	-	-		
HSL/00841/01	SL	Static on Paper machine 3 wind up control panel	-		07:52 - 11:57	235	11.6	n/a	-	-		
HSL/00842/01	SL	Static on Paper machine 3 wind up control panel	-		07:52 - 11:57	235	-	-	Sample spoiled but 1.95 max			
Exposure limits			LTEL (8 Hour TWA)				10		4			
			STEL (15 minute)				-		-			

Industry and SIC Code PAPER AND BOARD

Reason for monitoring INFORMATION GATHERING

Biological monitoring NO

Exposure details			Control measures		Related records
Conditions	Frequency	Metabolic rate	RPE	LEV	
N	C	MP	N	Y	
N	I	MP	Y	N	
N	I	MP	Y	N	
N	C	MP	N	Y	
N	I	MP	Y	N	

Comments on origin of sampled material e.g. product name

Comments on exposure modifiers, e.g. skin contact, other relevant jobs, confounding factors, biological monitoring

REGULAR 12 HOUR SHIFTS

APPENDIX 2 - RESULTS CONVERSION

HEALTH & SAFETY LABORATORY

Environmental monitoring Data

BOHS British Occupational Hygiene Society

Author R GUIVER
Tel No. 0114 289 2713

File reference	Reference to related records	Date of sampling	Total no of people on site 200	Agent		Inhalable Particulate					
Occupier of premises				CAS No.							
Address of premises/Location/Identity Conversion Company 2				Units		mg/m³					
				Sampling/Analysis Details							
		Post Code		MSDS Ref		MDHS14/3					
Department/Area Production				Males exposed		15					
Building/Room				Females exposed		15					

Reference Number	Sample type	Sample description (eg name/task/process/equipment	Male Female	NI no. Personal no.	Sample period	Duration (Mins)	Result	TWA	Result	TWA	Result	TWA
	PL	Reeler Operator, Perini 9	M		08:05-12:35, 13:25-15:01	366	18.3	18.3				
	PL	Reeler Operator, Perini 10	M		08:12-12:37, 13:27-15:01	368	9.4	9.4				
	PL	Perini 2 Operator	M		08:16-12:42, 13:22-15:03	367	2.9	2.9				
	PL	Reeler Operator, Perini 8	M		08:24-12:13, 12:48-15:03	384	7.9	7.9				
	PL	Reeler Operator, Perini 5	F		08:30-12:15, 12:55-15:13	363	11.8	11.8				
	PL	Packing, Perini 5	F		08:34-12:15, 12:54-15:13	360	3.1	3.1				
Exposure limits			LTEL (8 Hour TWA)				10					
			STEL (15 minute)				n/a					

dustry and SIC Code PAPER						Comments on origin of sampled material e.g. product name
ason for monitoring R						
iological monitoring No						
xposure details			Control measures		Related records	
onditions	Frequency	Metabolic rate	RPE	LEV		
	C	MP	N	N		
	C	MP	N	N		Comments on exposure modifiers, e.g. skin contact, other relevant jobs, confounding factors, biological monitoring
	C	MP	N	N		
	C	MP	N	N		
	C	MP	N	N		
	C	MP	N	N		

HEALTH & SAFETY LABORATORY

Environmental monitoring Data

BOHS British Occupational Hygiene Society

Author R GUIVER
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File reference	Reference to related records	Date of sampling	Total no of people on site 200	Agent		Inhalable Particulate	Respirable Dust	
Occupier of premises				CAS No.				
Address of premises/Location/Identity **Conversion Company 2**				Units		mg/m³	mg/m³	
				Sampling/Analysis Details				
		Post Code		MSDS Ref		MDHS14/3	MDHS14/3	
Department/Area	Production			Males exposed		15	15	
Building/Room				Females exposed		15	15	

Reference Number	Sample type	Sample description (eg name/task/process/equipment	Male Female	NI no. Personal no.	Sample period	Duration (Mins)	Result	TWA	Result	TWA	Result	TWA
	PL	Reeler Operator, Perini 7	M		08 41-12 44, 13 20-15 21	364	12.6	12.6	-	-		
	SL	Below Web, Perini 7	-		08 45-12 23	218	54.9	-	-	-		
	SL	Below Web, Perini 7	-		08 45-12 23	218	-	-	7.4	-		
	PL	Operator, Hand Towels 2	M		09 02-12 38, 13 29-15 21	328	6.4	6.4	-	-		
	PL	Line Minder, 9 & 10	M		09 08-12 42, 13 24-15 27	337	2.9	2.9	-	-		
	PL	Operator DCM3	M		09 15-12 48, 13 18-15 30	355	5.8	5.8	-	-		
	PL	Line minder, By saw 7b.	M		09 41-12 45, 13 47-15 27	294	1.7	1.7	-	-		
Exposure limits			LTEL (8 Hour TWA)				10		4			
			STEL (15 minute)				n/a		n/a			

dustry and SIC Code Paper						Comments on origin of sampled material e.g. product name
ason for monitoring R						
ological monitoring No.						
posure details			Control measures		Related records	
nditions	Frequency	Metabolic rate	RPE	LEV		
N	C	MP	N	N		
-	-	-	-	-		Comments on exposure modifiers, e.g. skin contact, other relevant jobs, confounding factors, biological monitoring
-	-	-	-	-		
N	C	MP	N	N		
N	C	MP	N	N		
N	C	MP	N	N		
N	C	MP	N	N		

HEALTH & SAFETY LABORATORY

Environmental monitoring Data

BOHS British Occupational Hygiene Society

Author R Guiver
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File reference FS/RE/32/2000	Reference to related records	Date of sampling	Total no of people on site 160	Agent		Inhalable Dust					
Occupier of premises				CAS No.							
Address of premises/Location/Identity **Conversion Company 3**				Units		mg/m³					
				Sampling/Analysis Details							
		Post Code		MSDS Ref		14/3					
Department/Area Conversion				Males exposed		M & F 20 total					
Building/Room				Females exposed		-					

Reference Number	Sample type	Sample description (eg name/task/process/equipment	Male Female	NI no. Personal no.	Sample period	Duration (Mins)	Result	TWA	Result	TWA	Result	TWA
HSL/00451/01	PL	Perini operator and Team Leader	M		08:40 - 12:42	242	9.6	n/a				
HSL/00452/01	PS	Cleaning Perini line	M		13:30 - 13:49	19	19.5	n/a				
	CM	Perini Operator combined jobs	M		-	-	-	10.1				
HSL/00453/01	PL	Perini line take off and fork lift	M		08:45 - 12:46	268	2.7	n/a				
HSL/00454/01	PS	cleaning down Perini line	M		13:30 - 13:50	20	14.3	n/a				
	CM	Perini line take off and forlk lift combined jobs	M		-	-	-	3.3				
HSL/00455/01	PL	Perini line, take off and fork lift	M		08:50 - 12:50	240	2	n/a				
HSL/00456/01	PS	cleaning down Perini line	M		13:30 - 13:51	21	11.9	n/a				
	CM	Perini line take off and forlk lift, combined jobs	M		-	-	-	2.5				
Exposure limits			LTEL (8 Hour TWA)				10					
			STEL (15 minute)				-					

dustry and SIC Code PAPER AND BOARD

Comments on origin of sampled material e.g. product name

eason for monitoring INFORMATION GATHERING

ological monitoring NO

xposure details			Control measures		Related records
onditions	Frequency	Metabolic rate	RPE	LEV	
	C	MP	N	Y	
	I	MP	Y	N	
			N	N	
	C	MP	N	N	
	I	MP	N	N	
	C	MP	N	N	
	I	MP	N	N	

Comments on exposure modifiers, e.g. skin contact, other relevant jobs, confounding factors, biological monitoring

HEALTH & SAFETY LABORATORY

Environmental monitoring Data

BOHS British Occupational Hygiene Society

Author R Guiver
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File reference FS/RE/32/2000	Reference to related records	Date of sampling	Total no of people on site 160	Agent		Inhalable Dust					
Occupier of premises				CAS No.							
Address of premises/Location/Identity Conversion Company 3				Units		mg/m³					
				Sampling/Analysis Details							
		Post Code		MSDS Ref		14/3					
Department/Area Conversion				Males exposed		M & F 20 total					
Building/Room				Females exposed		-					

Reference Number	Sample type	Sample description (eg name/task/process/equipment	Male Female	NI no. Personal no.	Sample period	Duration (Mins)	Result	TWA	Result	TWA	Result	TWA
HSL/00457/01	PL	Paula O'Grady, No 4 Folder operator	F		09:03 - 13:03	240	1.3	1.3	-	-		
HSL/00458/01	PL	Andy Peach, Echo Winder Operator	M		09:10 - 13:12	242	3.6	3.6	-	-		
HSL/00459/01	PL	Lee Hilditch, packing, Echo line	M		09:15 - 13:10	235	2.4	2.4	-	-		
HSL/00460/01	PL	Sharon Rudkin, No 3 folder and Napkins	F		09:30 - 13:20	230	1	1	-	-		
HSL/00461/01	SL	Static on control panel by log roll, Perini m/c	-		09:18 - 13:30	252	6.5	n/a	-	-		
HSL/00462/01	SL	Static on control panel by log roll, Perini m/c	-		09:18 - 13:30	252	-	-	0.24	n/a		
Exposure limits			LTEL (8 Hour TWA)				10		4			
			STEL (15 minute)				-					

dustry and SIC Code PAPER AND BOARD

ason for monitoring INFORMATION GATHERING

ological monitoring NO

xposure details			Control measures		Related records
nditions	Frequency	Metabolic rate	RPE	LEV	
	C	MP	N	N	
	C	MP	N	N	
	C	MP	N	N	
	C	MP	N	N	

Comments on origin of sampled material e.g. product name

Comments on exposure modifiers, e.g. skin contact, other relevant jobs, confounding factors, biological monitoring

HEALTH & SAFETY LABORATORY

Environmental monitoring Data

BOHS British Occupational Hygiene Society

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File reference FS/RE/32/2000	Reference to related records	Date of sampling	Total no of people on site 100	Agent		Inhalable Dust			
Occupier of premises				CAS No.					
Address of premises/Location/Identity **Conversion Company 4.**				Units		mg/m³			
				Sampling/Analysis Details					
		Post Code		MSDS Ref		14/3			
Department/Area Prudho Mill				Males exposed		160			
Building/Room Machine House and Conversion				Females exposed		unknown			

Reference Number	Sample type	Sample description (eg name/task/process/equipment	Male Female	NI no. Personal no.	Sample period	Duration (Mins)	Result	TWA	Result	TWA	Result	TWA
HSL/00039/01	PL	Perini line 10 major blowdown	M		06:40 - 10:28	228	12.2	n/a				
HSL/00040/01	PL	Perini line 10 major blowdown	M		06:40 - 10:31	231	6.4	n/a				
HSL/00041/01	PL	Perini line 10 major blowdown	M		06:40 - 10:30	230	19.3	n/a				
HSL/00049/01	PL	Winder operator, Line 1	M		07:35 - 13:03	328	12.7	11.1	-	-		
HSL/00050/01	PL	Winder operator, Line 12	M		08:00 - 09:16	76	7.2	6.3	-	-		
HSL/00051/01	PL	Cleaner, Conversion Hall 1	M		07:40 - 13:10	330	1.7	1.5	-	-		
HSL/00052/01	PL	Process operator, Perini line 11	M		07:49 - 12:20	271	16	14	-	-		
HSL/00053/01	PL	Process operator, Perini line 11	M		07:50 - 12:50	300	4.6	4	-	-		
HSL/00054/01 & HSL/00055/01	SL	Static Centre of Line 11 area	-		08:28 - 12:55	267	22.6	n/a	6.3	n/a		
Exposure limits			LTEL (8 Hour TWA)				10					
			STEL (15 minute)				-					

dustry and SIC Code PAPER AND BOARD						Comments on origin of sampled material e.g. product name
ason for monitoring INFORMATION GATHERING						
ological monitoring NO						
posure details			Control measures		Related records	
onditions	Frequency	Metabolic rate	RPE	LEV		
	I	MP	N	N		
	I	MP	Y	N		Comments on exposure modifiers, e.g. skin contact, other relevant jobs, confounding factors, biological monitoring
	I	MP	N	N		
	C	LP	N	N		
	C	LP	N	N		
	C	LP	N	N		
	C	LP	N	N		
	C	LP	N	N		

HEALTH & SAFETY LABORATORY

Environmental monitoring Data

BOHS British Occupational Hygiene Society

Author R Guiver
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File reference FS/RE/32/2000	Reference to related records	Date of sampling	Total no of people on site 180	Agent		Inhalable Dust	Respirable Dust	
Occupier of premises				CAS No.				
Address of premises/Location/Identity Conversion Company 5				Units		mg/m³	mg/m³	
				Sampling/Analysis Details				
		Post Code		MSDS Ref		14/3	14/3	
Department/Area Mill				Males exposed		75	75	
Building/Room Conversion				Females exposed		unknown	unknown	

Reference Number	Sample type	Sample description (eg name/task/process/equipment	Male Female	NI no. Personal no.	Sample period	Duration (Mins)	Result	TWA	Result	TWA	Result	TWA
HSL/00831/01	PL	Relief and core making for m/c 14	M		08:45 - 13:04	259	8.3	n/a	-	-		
HSL/00844/01	PS	Relief, Blowing down m/c 12 & 14	M		14:57 - 15:30	33	97	n/a	-	-		
	CM	Relief	M		12 hr shift	-	-	18.1	-	-		
HSL/00832/01	PL	Operator maintainer, m/c 14	M		08:45 - 12:54	249	10.1	n/a	-	-		
HSL/00843/01	PS	Operator maintainer, blowing down, m/c 14	M		14:56 - 15:27	31	210	n/a	-	-		
	CM	Operator maintainer,	M		12 hr shift	-	-	27.6	-	-		
HSL/00833/01	PL	Operator maintainer, m/c 12	M		08:47 - 13:04	247	13	n/a	-	-		
HSL/00845/01	PS	Operator maintainer, blowing down, m/c 12	M		15:00 - 15:27	27	235	n/a	-	-		
	CM	Operator maintainer,	M		12 hr shift	-	-	33.4	-	-		
HSL/00834/01	SL	Static, by phone booth between m/c 12 & 14	-		08:58 - 13:00	242	4.3	n/a	-	-		
HSL/00835/01	SL	Static, by phone booth between m/c 12 & 14	-		08:58 - 13:00	242	-	-	Sample spoiled but 2.6 max			
Exposure limits			LTEL (8 Hour TWA)				10		4			
			STEL (15 minute)				-		-			

dustry and SIC Code PAPER AND BOARD

eason for monitoring INFORMATION GATHERING

iological monitoring NO

xposure details			Control measures		Related records
onditions	Frequency	Metabolic rate	RPE	LEV	
N	C	MP	N	Y	
N	I	MP	Y	N	
N	C	MP	N	Y	
N	I	MP	Y	N	
N	C	MP	N	Y	
N	I	MP	Y	N	

Comments on origin of sampled material e.g. product name

Comments on exposure modifiers, e.g. skin contact, other relevant jobs, confounding factors, biological monitoring

REGULAR 12 HOUR SHIFTS

HEALTH & SAFETY LABORATORY

Environmental monitoring Data

BOHS British Occupational Hygiene Society

Author R Guiver
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File reference FS/RE/32/2000	Reference to related records	Date of sampling	Total no of people on site 180	Agent		Inhalable Dust					
Occupier of premises				CAS No.							
Address of premises/Location/Identity Conversion Company 5				Units		mg/m³					
				Sampling/Analysis Details							
		Post Code		MSDS Ref		14/3					
Department/Area Mill				Males exposed		75					
Building/Room Perini Conversion				Females exposed		unknown					

Reference Number	Sample type	Sample description (eg name/task/process/equipment	Male Female	NI no. Personal no.	Sample period	Duration (Mins)	Result	TWA	Result	TWA	Result	TWA
HSL/00827/01	PL	Operator maintainer, Perini	M		06:46 - 10:58	252	27.9	n/a				
HSL/00828/01	PL	Operator maintainer, Perini	M		11:30 - 12:33	63	21.4	n/a				
	CM	Operator maintainer, Perini	M		12 hr shift	-	-	37				
HSL/00829/01	PL	Perini relief worker	M		07:00 - 11:04	244	10.9	16.35				
HSL/00830/01	PL	Operator maintainer, Perini	M		07:44 - 11:34	230	27	40.5				
Exposure limits			LTEL (8 Hour TWA)				10					
			STEL (15 minute)				-					

ıdustry and SIC Code PAPER AND BOARD					Comments on origin of sampled material e.g. product name
eason for monitoring INFORMATION GATHERING					
iological monitoring NO					
xposure details			Control measures		Related records
onditions	Frequency	Metabolic rate	RPE	LEV	
N	IC	MP	N	Y	
N	C	MP	N	Y	Comments on exposure modifiers, e.g. skin contact, other relevant jobs, confounding factors, biological monitoring
N	C	MP	N	Y	
N	C	MP	N	Y	REGULAR 12 HOUR SHIFTS
N	C	MP	N	Y	