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CARE GUIDANCE

RECOMMENDATIONS ON BEST PRACTICE

LEVEL 2

Local Exhaust Ventilation (LEV) Systems for High Temperature Insulation Wool (HTIW)

LOCAL EXHAUST VENTILATION (LEV) SYSTEMS FOR HTIW

INTRODUCTION

This is a level 2 document in the ECFIA CARE Guidance series and should be read in conjunction with the level 1 document „Working with HTIW – Effective Risk Management".

Control measures are generally a combination of technological solutions and working practices to eliminate or reduce exposure. Selecting the right combination is very important and measures will only work effectively if they are properly applied.

Local exhaust ventilation is one of the various aspects of exposure control that need to be considered. Other considerations include:

- Operational processes within the workplace
- Where and how people work
- General ventilation in the workplace environment

Effective control will comprise a number of measures.

WHAT IS THE CARE PROGRAMME?

ECFIA´s Controlled And Reduced Exposure (CARE) Programme is an important part of the Product Stewardship Programme. It allows employers to proactively minimize fibrous dust exposure and thus protect workers' health.

WHAT ARE THE CARE GUIDANCE DOCUMENTS?

These documents form a comprehensive library of information on the safe handling and use of HTIW products. They have been written by industry experts and are designed to give customers of ECFIA members helpful information to put in place effective controls to minimise exposure to airborne fibres. This series of documents will progressively grow as new documents are produced.

Level 1 guidance document: "Working with HTIW - Effective risk management"
Level 2 guidance documents: Risk management measures applicable to HTIW
Level 3 guidance documents: Examples of specific applications

WHAT IS LEV?

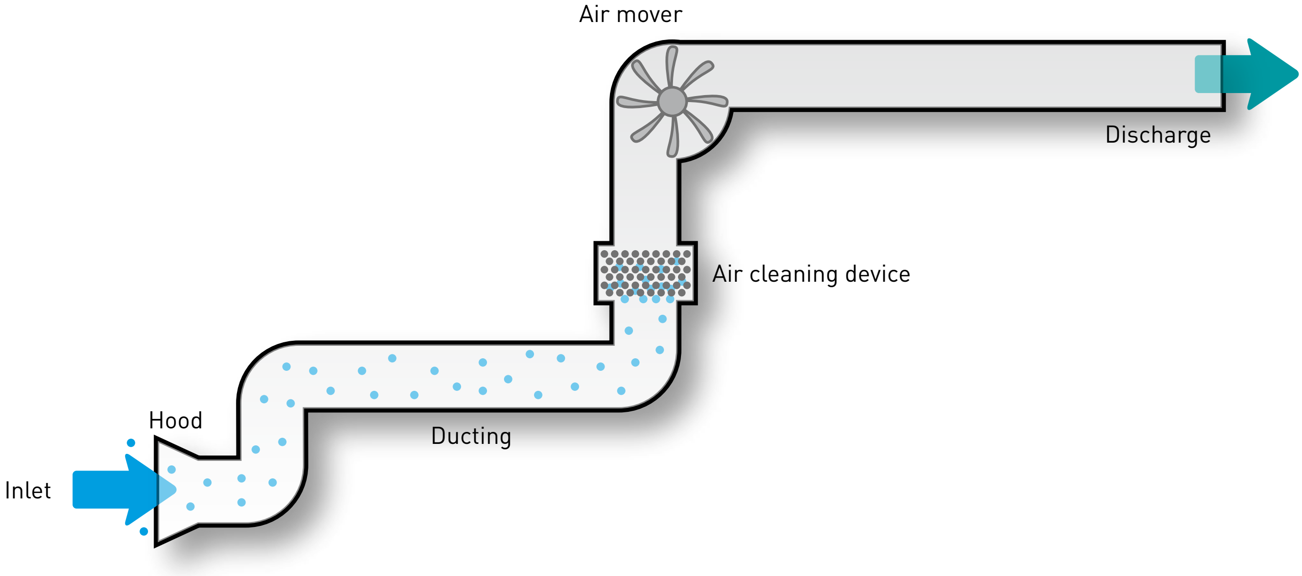
LEV systems operate on the principle of capturing a contaminant at, or as close as possible to, the source of emission.

The first consideration should always be to avoid generating emissions.

If emissions cannot be avoided, LEV is the preferred method of control.

It is most effective to collect the emissions as close to the source as possible and to minimise the open face of the hood as this necessitates a lower volume flow rate and achieves better capture. If the systems are correctly designed they will not only be more efficient but also use less energy.

LEV systems are comprised of four main elements: a hood, ducting, an air cleaning (filtering) device and a fan (air mover).



The hood, which may have a variety of forms, collects the contaminant and the duct transports it in the air stream to the air cleaning device. The contaminant is removed by the air cleaning device and clean air is exhausted after the fan.

The design of an LEV system needs to take account of the nature of the contaminant. For example, for HTIW there is a need to consider the density, abrasive nature and small size of the fibrous dust. The system also needs to be designed to overcome any cross-drafts. Operator movement and random air currents will need to be considered as they can adversely affect the capture velocity.

HOOD DESIGN

Hoods need to be specifically designed for the particular application. The hood must maintain an even air flow and sufficient capture velocity and/or face velocity, depending on the type of hood (cf annex), to control the motion of the contaminant laden air.

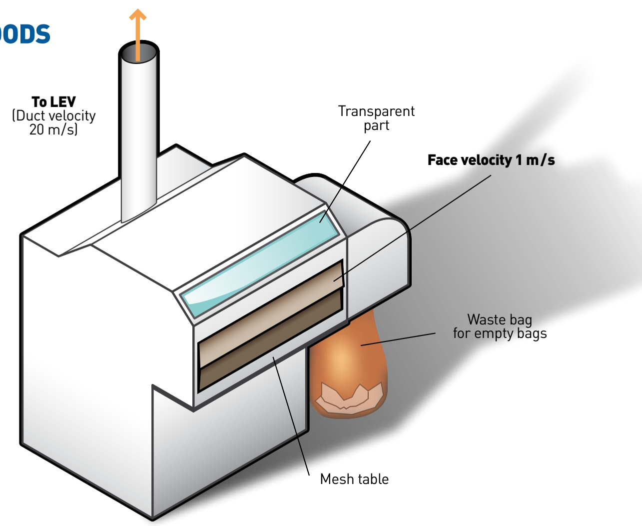
The capture velocity needs to be sufficient to maintain an effective inward flow taking into account the nature of the dust generating source/process:

NATURE OF SOURCE	EXAMPLE	CAPTURE VELOCITY REQUIRED AT THE POINT OF DUST GENERATION
Low velocity emissions	Conveyor transfer, unrolling blanket, cutting blanket and most manual handling	approx. 1 m/s
Moderate velocity emissions	Textile braiding, spinning, weaving	1 to 5 m/s
High velocity emissions	Band sawing, machine finishing (linishing, routing, drilling)	5 to 25 m/s

The effectiveness of LEV control systems relies on the correct selection and design of the hood for the process, the activity level and amount of product handling and product-operator interaction. Hoods have a wide range of shapes, sizes and designs. They fall into three basic categories reflecting their essential features:

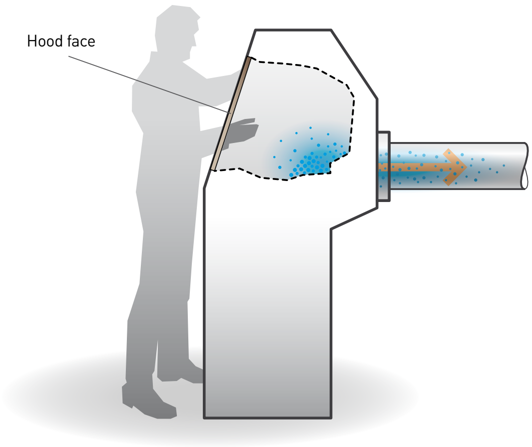
Enclosing hoods (Total or Partial Enclosure)
Receiving hoods (Receptor)
Capturing hoods (Captor)

ENCLOSING HOODS



Total enclosure

The machine/equipment and therefore the emission source is completely enclosed. There is still a requirement to maintain the enclosure under negative pressure to prevent emissions from the enclosure into the workplace. Consideration also needs to be given to the provision of access points to enable the enclosure to be cleaned.



Partial enclosure

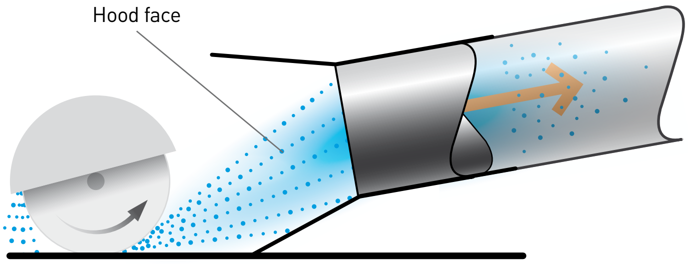
With partial enclosure the source of contamination is located inside the enclosure. Air flows from the open face of the enclosure and across the source to extraction openings located in the rear, top or bottom of the enclosure.

Partial enclosures must be large enough to contain the work and the air flow must be capable of guiding the contaminant towards an extraction point once released.

EXAMPLES OF PARTIAL ENCLOSURE

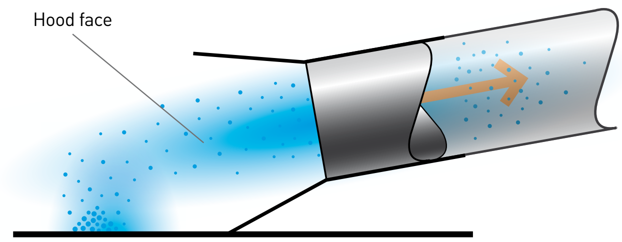
RECEIVING HOODS (RECEPTOR)

A receptor hood is used where the contaminant is generated with considerable momentum and the hood is placed in the path of the moving airstream to collect and remove the contaminant.

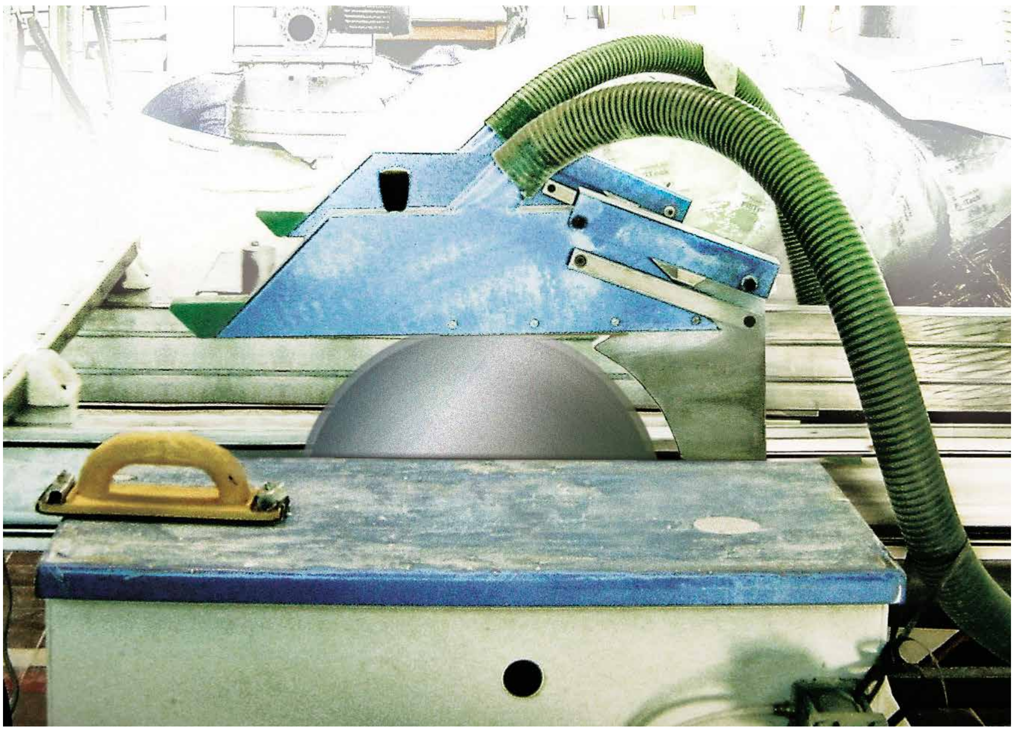


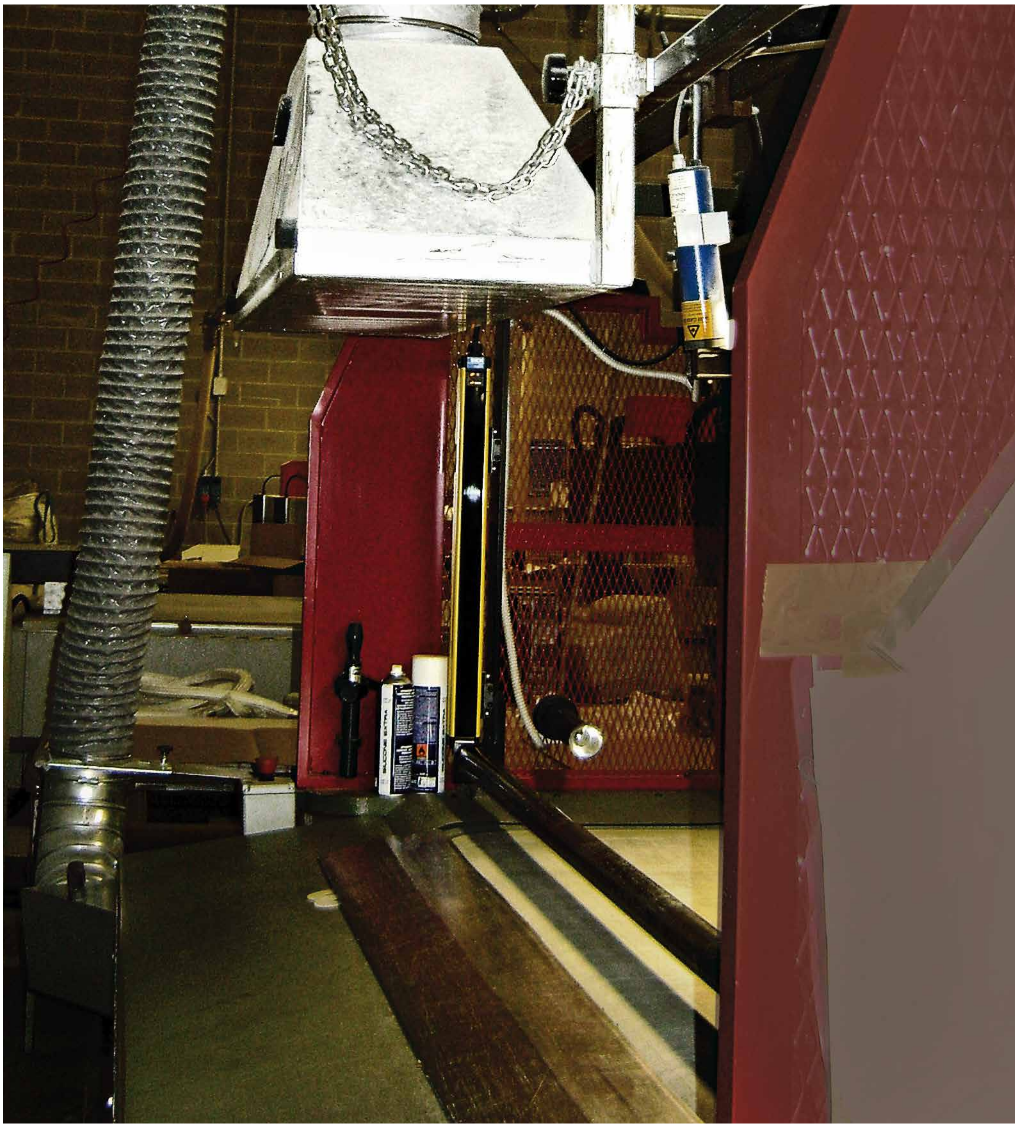
CAPTURING HOODS (CAPTOR)

A captor hood is used where there is no initial tendency for the contaminant to enter the LEV system and the energy required to provide movement in the right direction is supplied by suction at the hood.



EXAMPLES OF CAPTOR HOODS





POINTS TO CONSIDER IN LEV SYSTEM DESIGN

As previously mentioned the air velocity and volume are critical to the extraction efficiency of the hood. The rest of the LEV system has to transport the dust laden air from the hoods to the discharge, maintaining adequate air velocity. The main aspects to consider are the ductwork, the fan and the dust collection system (e.g. filtration prior to discharge).

For further detailed information please refer to UK's Health and Safety Executive document HSG 258.

DUCTWORK

By having the correct choice of ducting in terms of material, length and radius and by limiting the number of bends and junctions at the design stage the better balanced and effective the system will be.

With the correct ducting design the optimum transport velocity can be achieved and maintained.

The appropriate transport velocity will depend on the properties of the airborne material (nature of the substance, particle size, density, abrasiveness).

TYPICAL TRANSPORT VELOCITIES

TYPE OF POLLUTANT	RECOMMENDED TRANSPORT VELOCITY (M/S)
Gases	5 -10
Light particulate loading (cellulose fibres, wood dust)	15 -18
Normal particulate loading (HTIW, sand)	18 -23

Ducting on the extraction side of the system is under negative pressure (i.e. lower than that in the workplace), whereas the ducting on the discharge side of the fan will be under positive pressure (i.e. higher than that in the workplace).

The ductwork should be smooth-bore to reduce friction and pressure losses. The length of any horizontal runs should be kept to a minimum when transporting dust particles. In order to maintain transport velocity in straight runs, tapered sections should be incorporated. If and when changes of direction are necessary, they should be made smoothly. Sharp changes (i.e. T junctions or right angled bends) should be avoided.

There is also a need to avoid the use of long lengths of flexible ducting as this has a high flow resistance and low resilience. Flexible ducts can wear, split and are easily damaged.

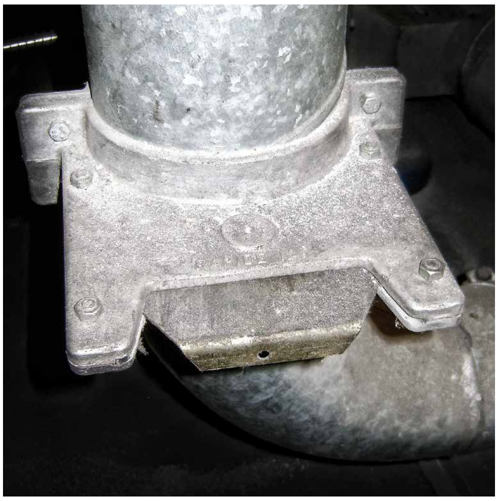
There is a need to regularly check the ductwork to ensure there is no drop out, blockage or general wear and tear. Therefore access points should be provided to allow the system to be easily inspected and cleaned.

MULTIPLE BRANCHED SYSTEMS

Ventilation systems with several branches supplying a single cleaning device are quite common:

Air will always take the path of least resistance. If the system design does not allow for the correct distribution of air flow in a multi-branched system an imbalance of the air pressure will occur, resulting in an ineffective air velocity. It is therefore essential that the system is correctly designed and balanced. The design calculation is based on the branch of greatest resistance (inlet farthest from the fan).

One way to balance a branched extraction system is to introduce dampers on each of the branches throughout the system. Dampers can be adjusted to afford the desired airflow at each branch/hood.



Closed

Open

Adding extra branches to an existing system can be detrimental to the overall system function and may require redesign rather than use of dampers.

DUST COLLECTION EQUIPMENT (DCE) – (SYNONYMS AIR CLEANER, BAG HOUSE, FILTER UNIT)

Dust collection equipment may comprise one or more of a number of different devices, including:

- fabric filters
- cyclones
- electrostatic precipitators
- scrubbers

Fabric filters are more suited to dry dusts. In this process the dusty air passes through a fabric layer that is flexible and porous. The dust particles are then removed by:

- impaction where the particles are larger than the weave, or
- impingement, where medium-size particles are extracted, or
- diffusion; when the particles are small they are attracted towards the fibres making up the weave.

FANS

A fan is an air mover that draws dust laden air from the hood, through the ductwork to the discharge. There are three main categories of fan:

- propeller
- axial
- centrifugal

Propeller fans

Propeller fans are used for general or dilution ventilation and are unsuitable for ducted systems with high resistance or carrying particulate matter.

Axial fans

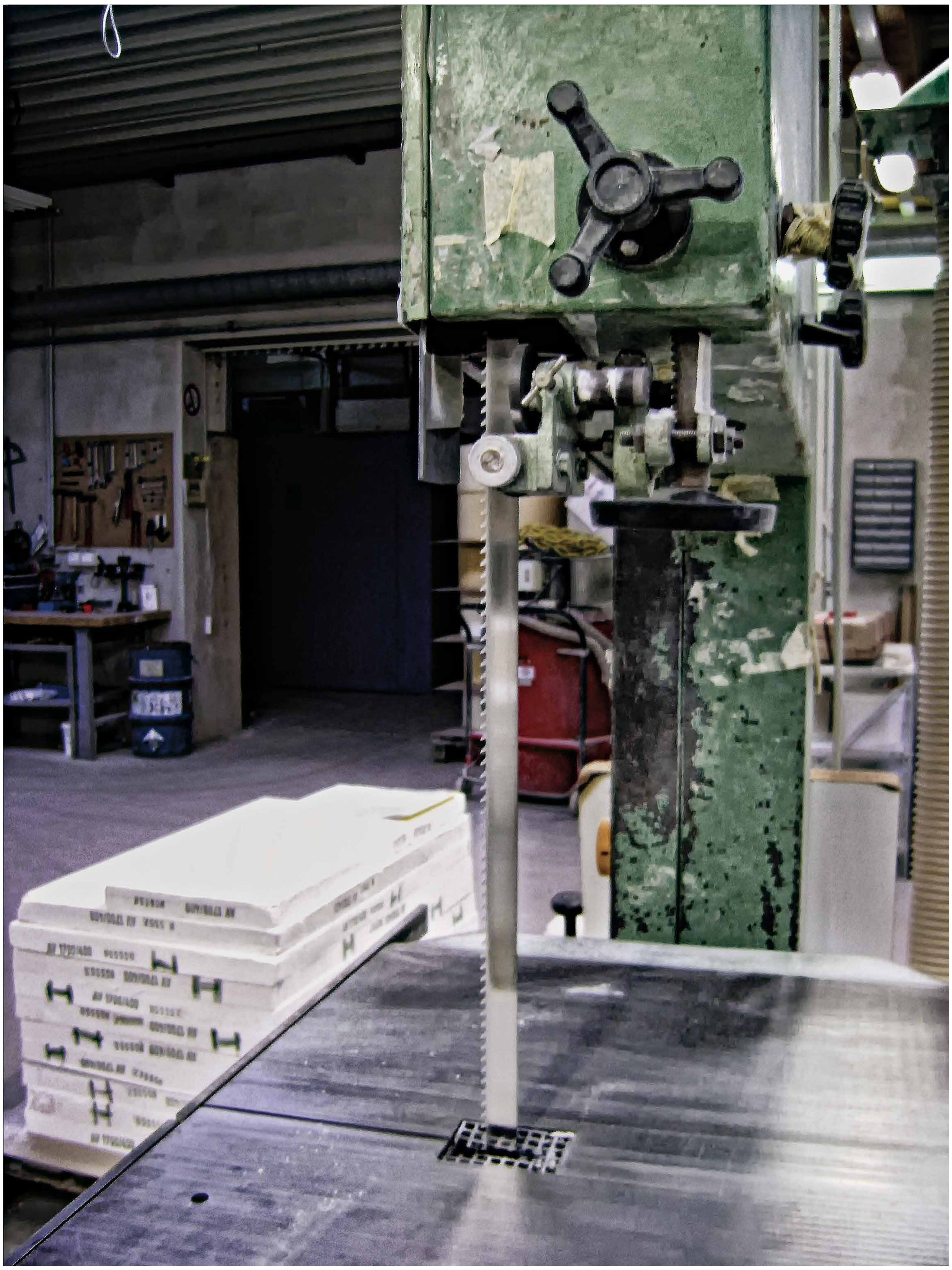
Axial fans are compact, but do not develop high pressures and cannot overcome the resistance to flow that many industrial applications require. Axial fans are not suitable for dusts.

Centrifugal fans

Centrifugal fans are the most commonly used fans for LEV systems. They generate large pressure differences and can produce airflows against considerable resistance. There are a number different types of centrifugal fan available, with differing blade design and function. Radial blades (paddle type) can convey heavy dust or product loadings and are often the most common solution for dust laden air streams. They should be placed after the filtration device to avoid fast wearing of the blades and shell.

EXAMPLES OF LEV IN INDUSTRIAL USE FOR HTIW

BAND SAW WITHOUT LEV



BAND SAW WITH LEV ON BLADE

LEV above blade
duct velocity 20 m/s

LEV at blade
duct velocity 15-20m/s

LEV at bottom of the
blade

Duct velocity: 20 m/s
Capture velocity: 15-20 m/s at blade
Fibre concentration without LEV 3-5 f/ml with LEV 1 f/ml (depending on product)

Use of a band saw is a high energy process, and there is a need to extract as close to the blade as possible and to enclose the blade as much as possible. When cutting a fibre-based product the emission of dust containing respirable fibre will be high if uncontrolled.

HTIW produce dusts that are relatively heavy and thus the transport velocity needs to be high enough to keep the dust suspended and it is simply required to be maintained at around 18-20 m/s.

MIXING TANK WITH LIMITED LEV BUT NO ENCLOSURE

Measured fibre concentration: 1.23 f/ml (with limited LEV)

THIS MIXING TANK WAS THEN COVERED, A PARTIAL ENCLOSURE AND LEV WAS ADDED

More emphasis was placed on enclosing the tank as much as possible and extracting at the point of addition to effect better control.

In this way (adding enclosure and LEV) fibre concentration was reduced to 0.33f/ml.

SOME SOURCES OF EXPERTISE

Occupational hygiene

A source of expertise which should include people with a wide range of the skills and competencies to develop effective exposure control measures and test their effectiveness is the Faculty of the British Occupational Hygiene Society (FBOHS) (free) Directory of Members.

Ventilation

One source of companies who claim competence and experience in LEV design is the Heating and Ventilation Contractors Association (HVCA)[1]. The Membership Directory is free, available on the Internet and divided up by geographical area and specialist subjects, including LEV. Another source of expertise is the Chartered Institute of Building Service Engineers (CIBSE)[2] membership directory which covers individuals and companies. There will be some overlap between the HVCA and CIBSE lists.

FOR FURTHER DETAILS ON LEV DESIGN, SEE:

HSE LEV Website and **HSG258**

INRS Website. Use the search function (Rechercher) on the main site.

General principle	ED 695
Wood transformation	ED 750
Dusty material	ED 767
Dust capture device design for wood machines	ED 84

1 HVCA 34 Palace Court London W2 4JG Tel: +44 (0)20 7313 4900 Website www.thebesa.com

2 The Chartered Institution of Building Services Engineers 222 Balham High Road Balham London SW12 9BS Tel +44 (0)20 8675 5211 Fax +44 (0)20 8675 5449 Website www.cibse.org