Safe collection of woodwaste: Prevention of fire and explosion

Woodworking Sheet No 32

Introduction

This information sheet is currently awaiting revision. Although most of the technical advice remains applicable, elements of the legal framework have changed. Up-to-date information is contained in HSG103 *Safe handling of combustible dusts* (Second edition 2003),[1] and the Approved Codes of Practice and Guidance for the Dangerous Substances and Explosive Atmospheres Regulations 2002.[2]

This sheet is one of a series produced by HSE's Woodworking National Interest Group in agreement with the Woodworking Machinery Suppliers Association. It gives practical guidance to manufacturers, suppliers and users of woodwaste collection systems on the reduction of fire and explosion risks.

Key legal requirements covering the supply and use of woodwaste collection systems are contained in the Supply of Machinery (Safety) Regulations 1992 (as amended); section 6 of the Health and Safety at Work etc. Act 1974 (HSW Act); section 31 of the Factories Act 1961; the Management of Health and Safety at Work Regulations 1999; and the Provision and Use of Work Equipment Regulations 1998 (PUWER).

Hazards

Wood dust is considered to be explosive if ignition of part of a cloud of wood dust results in the propagation of flame through the rest of the cloud. The vigour of flame propagation will vary from dust to dust and not all flammable dusts are equally explosive.[1]

The burning of an unconfined wood dust cloud produces a flash fire. If the wood dust is contained within a full or partial enclosure, the pressure build up can produce a destructive explosion. Its severity will depend on the type and concentration of the dust, the size of the source of ignition and the strength of the enclosure.

Generally, the larger the volume of the exploding dust cloud, the more widespread its effects will be. It is important to ensure that wood dust does not escape from collection systems and be allowed to accumulate within workrooms.

If dust does accumulate, any primary explosion which occurs in a collection unit may stir up dust deposits within the building which houses the plant. Burning particles from the primary explosion can ignite the dust cloud which results from it, leading to a secondary explosion that is usually more destructive than the first.

The explosibility of woodwaste

Assume that all woodwaste is potentially explosive, unless a dust explosion test[1] demonstrates it is not. Woodwaste usually has a dust explosion risk where the mean particle size is less than 200 microns and where as little as 10% of the mixture contains dust less than 80 microns in size. Only weak explosions are likely where the mean particle size exceeds 200 microns.

Woodwaste is commonly produced by:

- fine cutting (eg sanding) which produces a dust of very fine particle size. This is usually assumed to be explosible;
- machining and sawing softwoods which produces chips, shavings and coarse dust with only a small amount of fine dust. This does not normally create an explosion risk, so long as the fine dust is not allowed to separate and accumulate within confined spaces;
- sawing and machining hardwoods which often produces woodwaste containing considerably more dust than that from softwood. Assume this is explosible;
- the processing of MDF, chipboard and similar boards by machining and sawing. This can be expected to produce waste containing much fine dust. Assume this is explosible.

When mixed processing of a variety of woods and boards occurs, assume that the waste produced is explosible.

Sources of ignition

Common ignition sources include naked flames, faulty or unsuitable electrics and impact sparks.

The sanding or hogging of off-cuts containing metal inclusions may produce friction sparks which can cause saw dust to smoulder and be subsequently fanned into fires or explosions. Use dedicated collection systems for these operations. Consider spark detection and extinguishing devices where significant risks exist.

Hot work involving the careless use of welding or flame cutting equipment has resulted in many incidents. Isolate and thoroughly clean plant before work starts. Use cold cutting methods whenever possible.

Site electrical equipment away from dusty areas. If this is not practicable, make sure it is adequately protected.

Regulations on electrical equipment are due to change during 2003. Older equipment to BS 6467[3] remains acceptable, but new equipment will have to meet new standards for explosion protection (see BS EN 50281-3: 2002[4]).

Collection systems

There are a number of different systems for collecting woodwaste. The systems fall into three types:

1 One or more woodworking machines are exhaust ventilated to a nearby collection unit within the workshop which does not form part of any other exhaust ventilation system.

2 Many - perhaps all - of the woodworking machines are ventilated to a collection unit which can be some distance from the machines and may be situated inside or outside the workshop (see Figure 1).

3 One or more woodworking machines are exhaust ventilated to a nearby collection unit. These collection units deliver the woodwaste into a larger collection unit usually outside the workshop. This is known as a 'through flow' system.

Ductwork

Make ductwork as short as possible with a minimum number of bends. The design should specify a minimum transport (or conveying) velocity[5] of 20 m/s to minimise deposition of dust. Leave the fan running for a period of time after the machines have been turned off to ensure that the ducts are empty when the air flow stops and so minimise dust fall-out in the ducting.

Use only conductive materials for ductwork so that any static electricity generated can be discharged to earth.

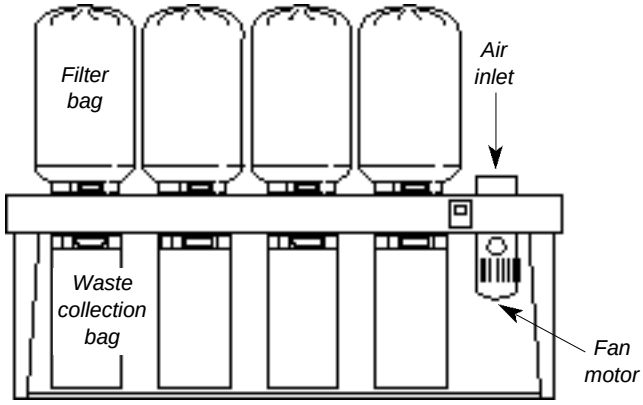
Ensure that ducting is subject to regular internal inspections and is cleaned frequently to remove any accumulations. Provide suitable access for this purpose.

Collection units

There are a number of different kinds of collection unit and the main types are:

- unenclosed fabric filter sock collector;
- unenclosed fabric multi-sock collector (see Figure 2);
- enclosed fabric single-sock collector;
- enclosed fabric multi-sock collector;
- cyclone;
- bin or hopper.

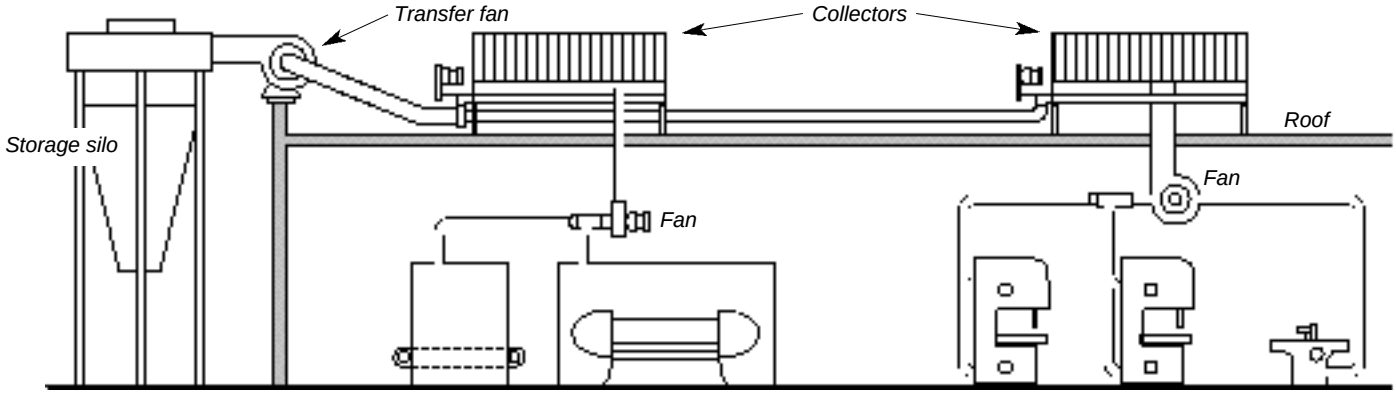
Figure 2 Unenclosed dust collector unit



Precautions for collection units where a dust explosion risk exists

Collection units should normally be sited outside away from areas frequented by people. If units have to be indoors, precautions will depend on the size of the collector; the size and construction of the room it is in; the number of people nearby; and the proximity to walkways and combustible materials.

Figure 1 Typical dust extraction system



Unenclosed sock collectors (<0.5 m^3/s capacity)

These would quickly disintegrate if the contents were ignited, but would not produce high explosion pressures or widespread effects. Fire risks may exist, so if unenclosed do not position them within 3 m of operatives, combustible materials or walkways. Alternatively, provide a suitable baffle or deflector plate or enclosure (see below).

Unenclosed sock collectors (0.5-2.5 m^3/s capacity)

Ignition of wood dust can lead to a jet of flame at head height, but an explosion is not expected. Where such collectors must remain within the workroom provide one of the following precautions:

1 Total enclosure within a strong metal cabinet provided with either an air outlet large enough in area to act as explosion relief or explosion vents. Outlets or vents should preferably discharge to a safe place outside the workroom or, if inside, discharge at least above head height.

2 A baffle or deflector plate made of non-combustible material to direct flames or burning material to a safe place.

3 Ensure the fan can be turned off from a safe place if a fire starts in the filter. A 3 m separation between the filter and regularly occupied locations is likely to be adequate to protect employees.

Unenclosed sock collectors (>2.5 m^3/s capacity)

Site these outside or enclose them in a strong cabinet fitted with explosion vents that discharge to a safe place.

Enclosed sock or fabric filter collectors (<0.5 m^3/s capacity)

The top of the enclosure may be open provided it discharges to a safe place, eg above head height.

Enclosed sock or fabric filter collectors (0.5-2.5 m^3/s)

Construct the enclosure as in point 1 above.

Enclosed sock or fabric filter collectors (>2.5 m^3/s)

The enclosure should be strong with explosion vents that discharge to a safe place.

Cyclones

Those of strong construction of less than 0.5 m^3/s volume (rare in woodworking) do not usually require explosion relief panels. Larger low-efficiency cyclones usually have large enough air outlets to act as an explosion vent. Larger high-efficiency cyclones do not usually have large enough air outlets to act as effective explosion vents and so additional venting will be necessary. Where cyclone air outlets discharge to an afterfilter, both the cyclone and the afterfilter will need explosion relief panels.

Bins or hoppers

Where used to store explosible woodwaste these will require explosion relief appropriate to their volume. They should preferably be sited outdoors but, if sited indoors, additional explosion relief may be required on the building itself.

Interconnected plant

Take precautions to prevent an explosion spreading between interconnected units of plant, such as collectors, cyclones, filters and incinerators.[1]

Collectors should discharge their collected woodwaste through an explosion choke, eg a rotary valve, or directly into strong metal containers clamped firmly to the discharge outlets.

Where rotary valves are intended to act as explosion chokes they need metal blades which are rigid enough not to deform under a pressure wave and which have as small a clearance as practicable from the casing.

Screw conveyors may be used to choke a dust explosion by omitting one turn of the flight. On an inclined conveyor the screw will not empty itself below the missing flight even when the supply of feed to the lower end is stopped. On a horizontal conveyor an adjustable baffle plate is needed to complete the seal of dust with the upper side of the casing.

Where the woodwaste is delivered out of the collector to downstream plant, eg feed bins for an incinerator, then it is necessary to stop at least every rotary valve discharge on the collector in the event of a fire or explosion. This can be achieved by arranging trip switches activated by explosion relief panels on the collector to cut the power or by fitting a pressure switch in the hopper.

Sizing of explosion relief

The simplest and commonest method of protecting process plant against the consequences of a dust explosion inside it is to provide some deliberate weakness. This is termed an explosion relief vent. If suitably sized and sited, an explosion within the plant will be vented safely.

A very old method of sizing explosion relief is the vent ratio rule. This rule is suitable for users to check that existing plant has enough explosion relief. For plant up to 30 m^3, a vent area of 1 m^2/6 m^3 of volume is prescribed. For plant of over 300 m^3 a vent area of 1 m^2/25 m^3 is recommended, and for plant of intermediate volume the vent area is adjusted linearly with volume. Seek specialist advice if you are unsure.

More recent research has provided better calculation methods. The nomograph method is the most useful method, and the one that should be used by designers.[1,6] Harmonised European Standards are being developed for many aspects of explosion protection.

Design of explosion vents

Vents normally take the form of bursting panels or explosion doors. Some types of panel are designed to tear at a pressure, others may bend or pop out from a rubber seal, or be held in place by magnets. To open rapidly, vents should be lightweight, normally less than 10 kg/m^2.

Panels which could become dangerous missiles in the event of an explosion should be attached by a restraint, eg a strong chain or cable. The chain needs to be long enough to allow the panel to open fully.

Ducting of explosion vents or panels to the open air

Wherever possible, duct explosion panels or vents and air outlets to a safe place in the open air. Make sure the explosion vent duct:

- is straight, although a single 90° bend is acceptable;
- is no more than 3 m in length;
- has a cross-sectional area equal to or up to 10% greater than the area of the vent or panel;
- is of strong construction.

If plant cannot relieve to a safe place in the open air, then blast deflector plates may provide limited protection. Where explosion vents cannot be ducted to the open air, the collector should be re-sited. If this is not possible they should not discharge into occupied workrooms or areas containing combustible material.

Firefighting

Consider installing a dry sprinkler system and a C-coupling for attachment to a fire-brigade hose (on new plant). Make sure access doors on silos are big enough to allow access for fire fighting. Use gently applied water (eg a spray or mist) and not jets to extinguish fire so as to minimise the disturbance of burning woodwaste.

Additional precautions

Some additional precautions to minimise fire and explosion risks include:

- ensure that there is a preventive maintenance regime for the entire collection system;
- keep the system dust tight;
- replace seals, gaskets and covers as necessary;
- empty containers associated with filters regularly;
- take care to prevent metal objects entering the collection system;
- smouldering fires often precede explosions - if a fire is suspected, stop the air flow through the collection system before investigating the problem.

References and further reading

1 *Safe handling of combustible dusts* HSG103 (Second edition) HSE Books 2003 ISBN 0 7176 2726 8

2 *Dangerous Substances and Explosive Atmospheres. Dangerous Substances and Explosive Atmospheres Regulations 2002. Approved Code of Practice and guidance* L138 HSE Books 2003 ISBN 0 7176 2203 7

3 BS 6467 (Part 1:1985, Part 2:1988) *Electrical apparatus with protection by enclosure for use in the presence of combustible dusts*

4 BS EN 50281-3: 2002 *Electrical apparatus for use in the presence of combustible dust. Classification of areas where combustible dusts are or may be present*

5 *An introduction to local exhaust ventilation* HSG37 (Second edition) HSE Books 1993 ISBN 0 7176 1001 2

6 Institution of Chemical Engineers *Dust explosion prevention and protection: A practical guide* ISBN 0 85295 410 7 (Available from Book Sales, Institution of Chemical Engineers, Davis Building, 165-189 Railway Terrace, Rugby, Warwickshire CV21 3HQ Tel: 01788 578214 Fax: 01788 560833 www.icheme.org/shop)

7 *Dust explosions from unenclosed sock filters* CRR176 HSE Books 1998 ISBN 0 7176 1577 4

Further information

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This leaflet contains notes on good practice which are not compulsory but which you may find helpful in considering what you need to do.

British Standards are available from BSI Customer Services, 389 Chiswick High Road, London W4 4AL Tel: 020 8996 9001 Fax: 020 8996 7001 Website: www.bsi-global.com

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