



# Storage of Wood Pellet and Wood Chip Fuel and Carbon Monoxide Generation

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# Introduction

- Since 2002 there have been at least nine fatalities world wide caused by carbon monoxide poisoning following entry into wood pellet storage areas.
- Domestic, commercial and industrial use of wood pellet boilers is now increasing in the UK.
- There is concern that the risks, particularly the release of carbon monoxide and absorption of oxygen during storage, are not understood.
- There are similar concerns over the use of wood chips.

# Project Aims

- Obtain information on how wood pellets and wood chips are stored in the UK.
- Assess risk management systems and controls.
- Measure gases and vapours in the stores, ventilation and the microbiological content of the fuel.

# Wood pellet and wood chip fuel

## Pellets



## Chips



# Associated hazards

- Gaseous toxic emissions,
- Asphyxiating atmospheres,
- Airborne dust (including fungal spores and bacteria),
- Explosive atmospheres,
- Spontaneous combustion,
- Confined spaces,
- Boiler exhaust fumes and burn back.

# Methodology

- Seven site visits.
- Interviews with staff to assess storage practice, risk management systems and controls and user knowledge.
- Air change rate measurements (IR spectrometer and SF<sub>6</sub> tracer gas).
- Real time measurement of CO, CO<sub>2</sub>, O<sub>2</sub> and CH<sub>4</sub> over ~28 days.
- Microbiological analysis of bulk fuel samples.

# Sites

- Six small-medium sized boiler systems (<250 kW) with associated storage (<15 tonnes): five wood pellet and one wood chip,
- One large scale wood pellet store (8000 tonnes),
- A purpose built store room,
- Converted barn, coal and grain stores,
- One GRP and two fabric silos.

# Site 1, GRP tower silo



No measurements made



# Site 2, purpose built store



Viewing window



# Site 3, converted barn wood chip store

Viewing window

Mirror



Tipping pit

Warning sign obscured  
when hatch door opened

# Site 4, fabric silo in former coal store

Slatted vent above door (out of view)

Access sleeve

Delivery pipe

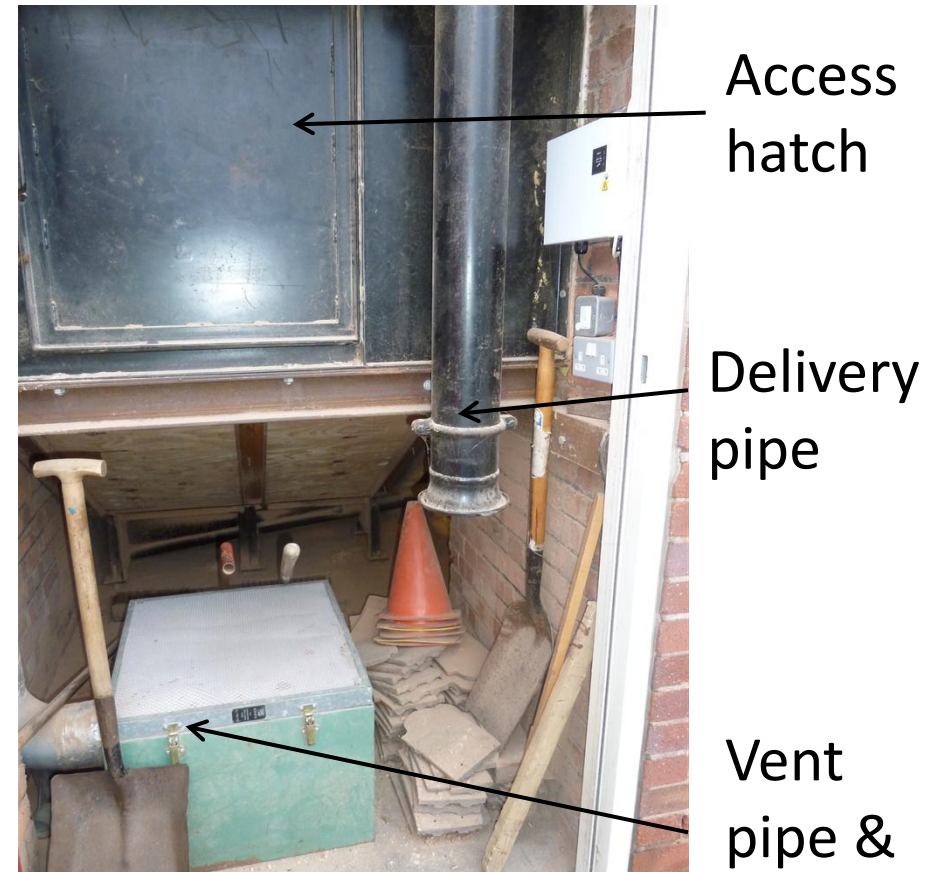
Woven fabric



Warning signs on both sides of door

Measurements taken adjacent to silo

# Site 5, converted coal store



No measurements made

# Site 6, fabric silo in boiler room

Anti-static  
woven  
plastic



Warning signs  
on both sides of  
boiler room  
door

Storage for  
cleaners

Measurements taken adjacent to silo

# Site 7, former grain store



Vent at both ends

Door left open  
for extra  
ventilation

Warning  
signs



# Controls

- All stores had restricted access.
- There was a limited and varied standard of warning signs.
- The small stores/silos did not have any planned ventilation.
- Personal CO monitors used at the large store, and domestic CO monitors at two small sites.
- No sites measured oxygen.

# Management

- There was limited knowledge of the hazards amongst operators of the small boiler systems.
- No risk assessments or safe working procedures at the small sites.
- Limited information concerning hazard from local suppliers of fuel or from companies installing and maintaining boiler systems.
- Large site had procedures, training, MSDS etc.



# Measurements

- No significant concentrations of carbon monoxide were detected (27 ppm peak, Site 7).
- Each site had a reasonably high ventilation rate (1.7 air changes/hr Site 2 to 20 air changes/hr Site 3).
- Very little microbiological contamination of pellets (not detected Sites 2 & 4; fungi 125 cfu/g, Site 7).
- Higher microbiological contamination of wood chips (bacteria  $1.8 \times 10^7$  cfu/g, Site 3).

# Wood chips

- Wood chips are more likely to present fuel transfer problems requiring intervention by staff.
- Risk of composting is much greater because of higher levels of moisture and microbiological contamination.
- Dangerous atmospheres (raised CO and CO<sub>2</sub>, and low O<sub>2</sub>) may be produced by chemical decomposition as well as microbiological processes.

# Recommended controls

- Prevention of dangerous gas levels accumulating (including low oxygen) by ventilation.
- Recognition as a confined space, i.e. restricting access to authorised workers with the necessary training.
- Having a safe system of work, including supervision, air quality checks, etc.
- Giving consideration to areas where escaped gases may accumulate.

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# Disclaimer

- This work was funded by the Health and Safety Executive (HSE). Opinions and conclusions expressed do not necessarily reflect HSE policy.