



Office Workers' Near Death Experience

By David Pearson, Head of Fire & Explosion Unit, TestSafe Australia

When internal combustion engines are used in poorly ventilated areas, the results can be tragic. In this toxic fume incident, carbon monoxide poisoned 48 office workers, 17 of which were taken to hospital.

Office workers got more than they bargained for when they attended work at Chubb Securities Ashfield on the morning of Friday 18 February 2000.

On this morning, construction work was being carried out in a ground floor room of the Chubb building, in order to create a passageway and a new canteen area (see Fig 1). This room was adjacent to an existing ground floor office (see Fig 2).

Part of the work involved cutting into the concrete floor to allow installation of plumbing services. Supercut Concrete Service Pty Ltd was contracted to undertake this cutting. The concrete saw used for this work was powered by a dual fuel (LPG or petrol) internal combustion engine (see Fig 3).

Supercut had converted this saw in 1999, to allegedly permit the use of LPG or petrol and to allow it to be used in an indoor environment.



Fig 1. Canteen area. Concrete saw (background)

The concrete saw operator started at about 9.30am. Within only 30 minutes, office workers had complained of headaches and left the office to go outside for fresh air. Although they could hear the saw operating, and smell the exhaust fumes, they were unaware that it was also poisoning them.

At 11.40am Chubb management was informed that Office workers were complaining of fumes, and a short time later that "people were sick". Chubb asked for better isolation between the new Canteen area and the Office.



Fig 2. The office area adjacent to the Canteen area.

At about 1:30 pm, Chubb Management asked for the sawing to stop, and the building was evacuated. By this time, the concrete saw is estimated to have been operating for a total of about 2 hours. It was in use continuously between 12.30 and 1.30pm.

In statements to the investigating inspector, Steve Jones, staff claimed to have symptoms ranging from headaches, dizziness, blurred vision, to shortness of breath. The accumulating effect of the fumes led to a large number of staff being nauseated, taken to Chubb's medical room and eventually taken to hospital.



Fig 3. Dual fuel concrete saw

TestSafe Australia's Fire and Explosions Unit was contracted by WorkCover to undertake a specialist investigation of the incident. Arrangements were made to transport the concrete saw to TestSafe where operational tests were conducted. The Mineral Resources Mine Safety Unit was enlisted for analysis of the exhaust gases. Testing revealed that carbon monoxide (CO) concentrations as high as 7% could be emitted from the exhaust of the saw. Calculations also showed that the gaseous volume of exhaust could exceed the total volume of air in the Canteen area.

The subsequent specialist report concluded that the office staff had been exposed to potentially lethal amounts of carbon monoxide gas emanating from the only possible source, the concrete saw. If the exposure had continued past 1:30 pm, it is clear that the staff would have suffered much more serious physiological symptoms.

Carbon Monoxide (CO) is an odourless, invisible and poisonous gas resulting from incomplete combustion of carbonaceous fuels. When CO is inhaled, it is very rapidly and preferentially taken up by the haemoglobin in the blood displacing oxygen to form Carboxyhaemoglobin (see Fig 4). Even very low CO concentrations can prove fatal over time. Its toxicity is simply due to the asphyxiation effect caused by the reduced availability of oxygen for body tissues. It affects some individuals, for example smokers, more quickly than others.

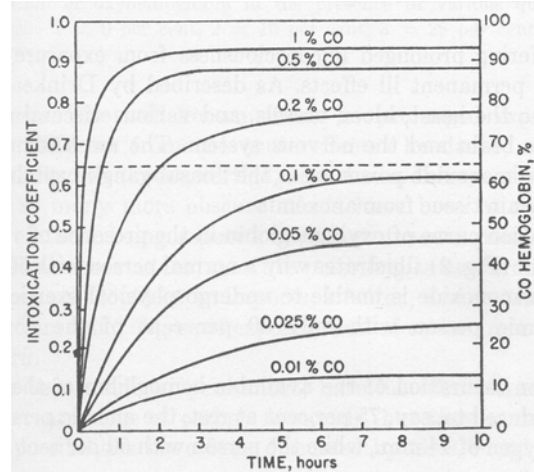


Fig 4. Speed of uptake of CO into the blood at inhaled concentrations up to 1%. Note the saw was emitting CO at 7%.

Carboxyhaemoglobin blood levels of 20% (see Table 1 on the next page) may be fatal to the foetuses of pregnant women and people with severe heart conditions. In the TestSafe expert report, it was speculated that the office workers could have been intoxicated at this level. In the subsequent prosecution undertaken by WorkCover, the Defence expert Toxicologist did not challenge this.

People with a level of 40-50% of Carboxyhaemoglobin in the blood will experience headache, confusion and collapse. A level of 80% will be rapidly fatal.



Fig 5. Some of the 22 missing ceiling tiles.

The question arose during the investigation as to why the office workers in the next room were so seriously intoxicated, and yet the operator of the concrete cutting machine was not affected at all. TestSafe's expert specialist report suggested the following mechanisms, which may have protected the saw operator: -

1. The effect of the buoyancy of the saw's exhaust plume, which would have caused the exhaust to rise to the ceiling, and away from the operator.
2. The presence of open air-conditioning ducting in both rooms.
3. The absence of 22 ceiling tiles in the suspended ceiling which may have allowed the buoyant exhaust to enter the common roof space to the Office area (see Fig 5).

WorkCover NSW prosecuted both the small business involved in concrete cutting, Supercut Concrete Services Pty Ltd, and the plumbing contractor, T Helsby and Sons Contracting Pty Ltd., under the relevant provisions of the occupational Health and Safety Act.

His Honour, Justice Roger Boland in his decision of 5 April 2004, accepted the expert witness report presented by TestSafe's David Pearson, and his hypothesis as to how the toxic gas came to affect the Chubb employees.

He found that the defendants failed to ensure that those employees were not exposed to risks to their health and safety. Supercut was fined a total of \$150,000 plus costs, and Helsby was fined \$220,000.

Carboxyhaemoglobin Concentration (%)	Principal Signs and Symptoms
0.3 – 0.7	No signs and symptoms. Normal endogenous level.
2.5 – 5	No symptoms. Compensatory increase in blood flow to certain vital organs. Patients with severe cardiovascular disease may lack compensatory reserve. Chest pain of angina pectoris patients is provoked by less exertion.
5 – 10	Visual light threshold slightly increased.
10 – 20	Tightness across the forehead. Slight headache. Visual evoked response abnormal. Possibly slight breathlessness on exertion. May be lethal to foetus. May be lethal for patients with severe heart disease.
20 – 30	Slight or moderate headache and throbbing in the temples. Flushing. Nausea. Fine manual dexterity abnormal.
30 – 40	Severe headache, vertigo, nausea and vomiting. Weakness. Irritability and impaired judgement. Syncope on exertion.
40 – 50	Same as above, but more severe with greater possibility of collapse and syncope.
50 – 60	Possibly coma with intermittent convulsions and Cheyne-Stokes respiration.
60 – 70	Coma with intermittent convulsions. Depressed respiration and heart action. Possibly death.
70 – 80	Weak pulse and slow respiration. Depression of respiratory centre leading to death.

*Table 1. Carbon Monoxide blood concentration and corresponding symptoms. There is considerable individual variation in the occurrence of symptoms.**

* Obtained from Worksafe Australia Website