Oxy torches and their effect on meat colour

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Hot flames from oxyacetylene torches produce nitrogen dioxide gas. Internal combustion engines also produce it. Nitrogen dioxide is an energetic oxidising agent and the gas can rapidly oxidise the purple or red forms of myoglobin in meat to brown metmyoglobin.

Oxyacetylene torches

Oxyacetylene torches are sometimes used in loaded chillers, freezers or stores, either for welding or for emergency thawing. This can sometimes have disastrous effects on the colour of the meat, due to the production of a brown or yellow pigment.

The association of discolouration with the use of an oxyacetylene torch in the confined environment of a chiller was confirmed by CSIRO some years ago. Briefly, two beef sides were boned out and placed in a chiller (5°C), which had a volume of approximately 27 cubic metres. An oxyacetylene torch was ignited and adjusted to give a neutral flame. The torch was left burning in the closed chiller for 30 minutes. Next morning all cut tissue surfaces were severely discoloured. There was a significant amount of brown metmyoglobin pigment in the surface tissue.

After the test, a member of staff identified the odour of nitrogen dioxide in the chiller. The concentration of nitrogen dioxide in the chiller was measured with test strips sensitive to nitrite or nitrogen dioxide. Operation of the torch for 30 minutes in a chiller of the above size resulted in a nitrogen dioxide concentration in excess of 50 ppm. The nitrogen dioxide seemed to be stable at the low temperatures in the chiller, and even after nearly five hours, the concentration was still 20-25 ppm.

In further tests, it was found that operation of the oxyacetylene torch in the chiller for a period of five to six minutes resulted in a nitrogen dioxide concentration of approximately 25 ppm, a concentration which caused significant discolouration of beef and mutton carcases. Carcases held in a chiller for 48 hours prior to exposure to nitrogen dioxide discoloured to a greater extent than carcases that were exposed a few hours post-slaughter.

The colour of meat resulting from the operation of oxyacetylene torches can range from dark brown to yellow. Affected carcasses in New Zealand were once described as having the appearance of extreme freezer burn.

The evidence shows quite clearly that welding torches should never be operated in the vicinity of meat (loaded chillers, freezers or stores, either for emergency thawing or for welding operations) unless very good ventilation is provided.

Internal combustion engines

Internal, combustion engines also produce nitrogen dioxide. A New Zealand company, which had a severe problem of carcase yellowing in a new bulk store, found that it was using forklifts powered by liquefied petroleum gas (LPG) within the store. This practice was discontinued.

Forklifts, other than electric, must be suspect when used for lengthy periods in unventilated areas such as meat chillers and freezers. In simple terms, the amount of nitrogen dioxide produced by an engine will be least at idling, and greatest when the engine is working hard (say, accelerating under heavy load). The only way that the amount of nitrogen dioxide produced can be controlled is by limiting the running time in the confined area, and ensuring adequate ventilation.

Careful tuning will minimise emissions of hydrocarbons, carbon monoxide and oxides of nitrogen. Emissions from engines of recent design are primarily controlled by catalytic converters. Three-way converters will reduce oxides of nitrogen to nitrogen and oxygen however they must be well maintained and replaced in accordance with instructions from the manufacturer.

Case studies of some occurrences

Butcher's shop chiller

The blower unit had iced up and needed repair. The refrigeration mechanic thawed it with an oxyacetylene torch and repaired it.

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Within a few hours all the exposed meat surfaces and mince in the chiller were brown.

The discolouration extended about 6-8 mm into the muscle and 12-16 mm into the mince. The discoloured areas were trimmed and discarded. About 130 kg in all was condemned as unsaleable.

Meatworks chiller

A LPG motor was run all day in an empty export chiller, and in another empty chiller several sections of rail were welded into place. A meat chiller next to these was charged with veal and mutton carcasses from the slaughter floor, and silversides from the boning room. Doors of all chillers were open all day.

The report of what was found next day is graphic:

'On entering the wholesale meat department I observed a number of veal and mutton carcasses, and a number of silversides which were pale greenish yellow in colour and dark in appearance.

The subcutaneous connective tissue and fat of the mutton and veal had a distinct greenish-yellow colouration like jaundice. The muscle had lost its bloom and it appeared as though the carcasses were a few days old and had been subject to incorrect handling and poor refrigeration.

Bruises, where they appeared, were clearly defined, being much darker than the surrounding tissue. Internal blood drip and clots were a distinct brownish colour and the surface had a dried out parchment-type appearance'.

Clearly the welding torch and the LPG motor produced nitrogen dioxide, which contributed to the discolouration.

Safety

It is widely accepted that carbon monoxide emission from internal combustion engines used in confined spaces is dangerous to man. There is also a danger from nitrogen dioxide. From a safety viewpoint, short exposure to concentrations of nitrogen dioxide greater than 5 ppm. is considered hazardous. The current standard limit for nitrogen dioxide is 0.12 ppm for one hour. The gas has an odour but is only slightly irritating to the respiratory tract. Therefore, dangerous amounts of the fumes may be breathed before any real discomfort is noticed. Toxic effects may occur after exposure to concentrations of 10 ppm for 10 minutes and include coughing, chest pain, and difficulty in breathing. Brief exposure to 200 ppm can cause severe lung damage, which may be fatal.

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