Confined spaces in the water industry

Are your workers safe?

MSA
The Safety Company

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Every day thousands of municipal and government employees as well as private contractors face many risks working in and around water and wastewater treatment plants. Potential risks include working in confined spaces, and fire and explosions due to hazardous gases.

There is a range of specialised equipment, codes of practice, regulations and standards directly aimed to provide protection for workers in confined spaces. It is one of the most highly focused areas of occupational safety, but some may question why there is so much attention and whether it is justified.

The answer to why is simple: Confined spaces are just not good places to work in. By definition they are not designed for ease of entry or with workers in mind. The confined space environment often has poor ventilation with hazards that can rapidly change and are not always obvious. Typically, they are visited infrequently and little is known about the conditions inside them or the consequences of undertaking work in them. This leads to several safety risks and requires strong mitigating strategies if workers are to be truly protected. So, what are the risks?

According to the SafeWork Australia approved Confined Spaces Code of Practice under section 274 of the *Work Health and Safety Act 2011* (WHS Act), the risks of working in confined spaces include:

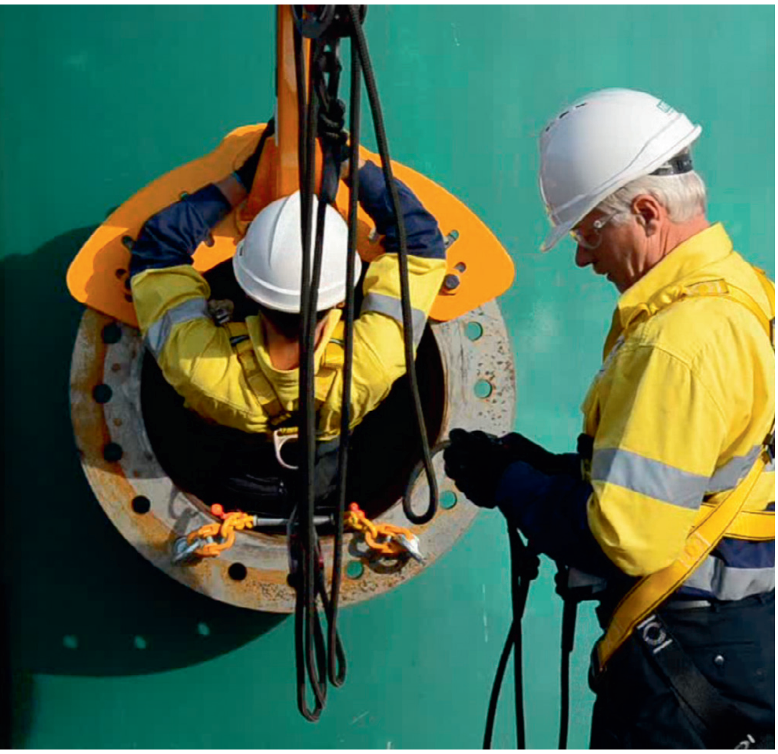
- loss of consciousness, impairment, injury or death due to the immediate effects of airborne contaminants;
- fire or explosion from the ignition of flammable contaminants;
- difficulty rescuing and treating an injured or unconscious person;
- asphyxiation resulting from oxygen deficiency or immersion in a free-flowing material, such as a liquid, grain, sand, fertiliser or water.

The primary risk is atmospheric risk as ventilation in confined spaces is typically poor. It pays to remember again that these environments are not designed for human occupation. Mostly, a confined space is devoid of occupation and serves to contain equipment or capture overflows such as sumps rather than serve as a workplace. Ventilation is not only something not present but, in some cases, is actually counterproductive to the normal function of the confined space. Unfortunately, what is good for equipment is not always good for workers. It seems obvious, but in the first instance, humans need CLEAN breathable air, not only to work but to survive. This is the major safety risk in confined spaces.

Historical statistics indicate accidents occurring in confined spaces have been more frequent and often more serious than accidents in other workplace environments. This is driven by the fact that when things go wrong in a confined space, it is difficult to rapidly respond and an already compromised work area becomes even more compromised. These same statistics show the most common source of injury relates either directly or indirectly to respiratory issues from toxic gases, depleted oxygen and, less frequently, but of greater consequence, explosions from combustible gases.

Putting it bluntly, workers need clean safe air - without it, their safety is compromised.

Yes, the attention to safety in confined spaces is justified and necessary!



Things to remember when working in confined spaces

- Confined spaces are areas of elevated risk.
- It is easy to become complacent.
- Safety equipment is used to warn of a potentially hazardous (albeit infrequent) situation so that workers can react appropriately.
- When needed, the equipment and training must work.
- Plan for the worst with rescue equipment, detectors and training.
- Failure to plan for risk can have dire circumstances.

How can the risks be mitigated?

Engineering away the risks is always, and should always be, the first action taken. However, this is not always practicable, so mitigation of the risk must be considered next.

In order to mitigate the risks, a few questions must first be asked:

1. What are the likely major sources of risk? For example, air quality will be always high on this list.
2. How do we confirm whether the risk actually exists and what assessments will be conducted? For example, usually a risk assessment will include at least a visual inspection and an air survey before entering the confined space.
3. If a risk exists, how severe is it and how can it be mitigated? For example, consider whether a source of fresh air could be supplied from outside to mitigate the risk.
4. Is the risk likely to change as a result of some external or internal activity while a worker is in the confined space? For example, a sudden rainstorm can inundate sumps and drains, and welding activity can reduce oxygen and generate carbon monoxide.
5. If the worst occurs, how does the worker escape quickly and safely, or how will the worker be rescued quickly and safely?

What about the cost?

Cost is a complex area and needs a good deal of attention. Of course, every organisation is under pressure to control costs, and expenditure for safety equipment used in a high-risk environment such as a confined space is more expensive than other areas. However, failure to plan and properly resource safety equipment expenditure could compromise safety and the consequences of such a decision may not be known until it's too late.

The challenge for safety professionals is trying to demonstrate the value of funding for circumstances that they hope will never occur. Often a compliance view takes precedence over the usual profit/loss calculations when presenting a case for funding.

What also needs to be understood is that a lack of incidents does not mean there is no risk. Safety expenditure is related to mitigating risk to workers and the safety devices are not in place to operate every day, but rather to perform on that one really bad day!

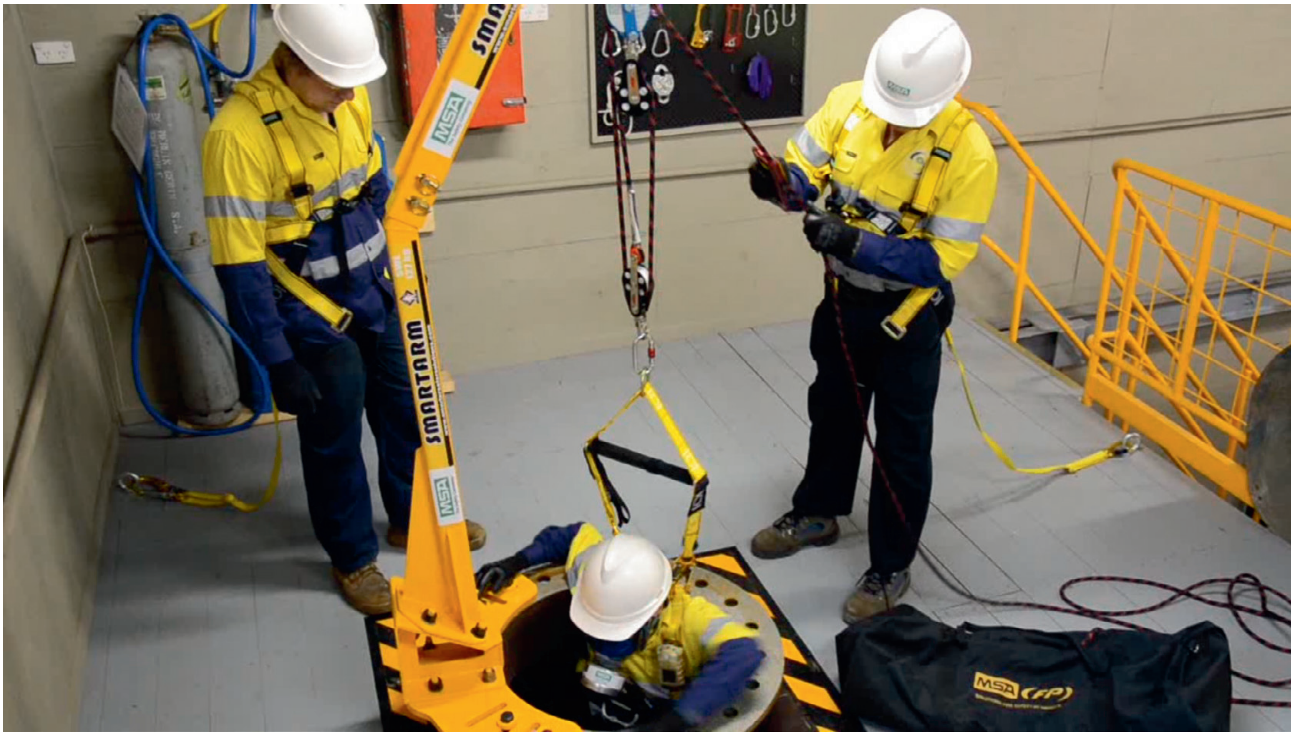
What equipment will I need?

Gas detection has a high profile of importance in confined spaces. This is driven by the historical observation that the majority of injuries in confined spaces have been respiratory related. Gas detectors aim to provide a profile of the breathability of the atmosphere before entering and during work within a confined space. These are critical devices that can provide warnings for a worker to take action to mitigate a respiratory risk when necessary. This can be achieved by not entering the confined space or, if already in the confined space, donning respiratory personal protective equipment or escaping. The question then becomes: if the atmosphere is the risk, why not just wear protective devices all the time?

Respiratory protective equipment is useful in confined spaces but can often be impractical due to space and work requirements. Restricted entry and the use of hoses can often mean that adoption of fresh air supply equipment can in itself present some risks. Filters can only be used for a limited number of times and certain concentrations of toxins. Gases can also be explosive, so respiratory protection is only a small part of the overall safety equipment solution for working in confined spaces.

Case study: A close shave in a confined space in New Zealand

The best way to demonstrate the importance of reliable safety equipment and well-trained workers in a confined-space environment is to show how it has been put into action in a real-life example. In this case study, Geoff Young talks about the detail of his close shave while working in a confined-space environment**.** At the time of the incident, Young was working for independent contractor BPO Ltd of Hamilton, New Zealand. Luckily for him, the outcome was positive and the safety equipment, testing and train-



ing that he originally considered merely as a 'competitive edge' proved to be more valuable than he ever imagined!

Here's his story:

"We purchased our original confined-space harness, rig and gas detector because it was a requirement of one of the companies we did work for. We undertook confined-space training to the AS/NZS standards for the same reasons. We saw the equipment and procedures more as a competitive edge rather than as a necessity. For this reason, we always followed the procedures and used the equipment. The equipment was always looked after and inspection certificates were kept current. At this time, many companies regarded the whole confined-space thing as a bit of an overreaction to a recent confined-space disaster in Auckland.

"We were working on a site with fermentation vessels. Our job was to climb down a 2.5 m manhole and inspect the flow measurement equipment in the bottom of the manhole. We went through the normal preliminary checks of taking the gas detector down to various levels and the readings were all normal. I was bigger than my co-worker Greg, so Greg went down the hole and I became the safety observer.

"Greg was already harnessed up, so as soon as the preliminary checks were complete, he clipped himself to the confined space rig and climbed down into the hole. Greg had only been in the workspace for a couple of minutes when a flush from a fermenter came down the drain. The site was quite noisy, so I couldn't hear the gas detector alarming but I could see the lights on the detector flashing. I called out to Greg for about 10 seconds but got no answer. At this point, the training took over. Greg was winched out of the manhole in a not-too-gentle fashion. Once on the surface, it became apparent that this was none too soon. Greg was only semiconscious.

"Greg only took a short time to recover. In the meantime, I checked the peaks on the gas detector. The O_2 level had dropped from its normal 20.8% to about 15%. When the fermenter flushed out, it also flushed the CO_2 with it.

"Greg said afterwards that shortly after the flush came through, he suddenly couldn't get his brain to work. He said he could hear the alarm going off but couldn't remember what it was for. He couldn't even figure out what he was doing in this manhole. Then, when he felt the winch start to haul him up he was almost grumpy because someone was disturbing his sleep.

"Since this close shave, we have taken confined-space entry very seriously. We now have two rigs, three MSA Altair gas detectors, two fan units for air displacement and all staff have regular training."

Facts associated with the case study

- Carbon dioxide (CO_2) is predominantly the by-product of fermentation and/or bacterial activity. It is colourless and essentially odourless. At 0.5% of atmosphere, it is considered chronically toxic. At 6%, CO_2 impairs mental capacity and at 10%, it is mostly fatal.
- A 6% replacement of air by CO_2 reduces O_2 levels to 19.6%, which may not trigger an alarm.
- The observed alarm indicates the CO_2 level may have reached 28%! Without a rescue system in place and quick action, death would have occurred.
- The additional benefit of a man-down alarm to detect an unconscious worker in these circumstances is invaluable.
- CO_2 should be detected directly using accurate, fast CO_2 sensors - a fact laboured in the Australian and New Zealand standards.

MSA has a full line of technology to provide detecting solutions for water and wastewater facilities monitoring. Products include gas monitors for continuous monitoring of gases and vapours such as oxygen, hydrogen sulfide and combustible gases such as methane. The equipment is built to withstand the demands of water and wastewater industries, with wireless and open path gas detectors and custom-designed systems to suit a specific application also available.

MSA Fixed Gas & Flame Detection Systems are designed to help our customers meet NFPA Standard 820 as indicated below.

Hazard Location	Flame Detection	Methane	Oxygen	Hydrocarbon	Chlorine	Hydrogen Sulfide	Carbon Monoxide	Carbon Dioxide	Sulfur Dioxide	Ammonia
ANAEROBIC DIGESTERS, BOTH FIXED & FLOATING COVER*		■	■			■		■		
DIGESTER CONTROL BUILDING		■	■			■				
DIGESTER GAS PROCESSING ROOMS		■	■			■				
UNDERGROUND (PIPING) TUNNELS CONTAINING NATURAL OR SLUDGE GAS PIPING	■	■	■			■				
IN-VESSEL COMPOSITING*	■	■								
ALCOHOL STORAGE		■	■							
INCINERATORS		■	■	■			■			
CHLORINATION ROOM					■					
CHLORINE STORAGE TANKS & ROOM					■					
AMMONIA STORAGE TANKS & PIPES										■
DE-CHLORINATION PROCESSES			■						■	
SULFUR DIOXIDE STORAGE TANKS									■	
WET WELLS (STORM WATER, RESIDENTIAL WASTEWATER)		■	■			■				
PUMPING STATIONS		■	■			■				
COURSE & FINE* SCREEN FACILITIES		■	■			■				
FLOW EQUALIZATION TANKS*		■				■				
GRIT REMOVAL TANKS*		■	■			■				
PRE-AERATION TANKS*		■				■				
PRIMARY SEDIMENTATION TANKS*		■	■			■				
OXYGEN AERATION TANKS		■								
SCUM HANDLING BUILDING*		■	■			■				
SCUM PITS*		■	■			■				
SCUM PUMPING AREAS* WET & DRY SIDE		■	■			■				
SLUDGE THICKENER*		■	■			■				
SLUDGE STORAGE AREAS*		■	■			■				
SLUDGE BLENDING TANKS* AND HOLDING WELLS		■	■			■				
ODOR CONTROL SYSTEM ACCESS	■	■				■				
COMPOSTING PILES	■									
DEWATERING BUILDINGS	■									
ANAEROBIC DIGESTION GAS STORAGE		■								
UNDERGROUND (PIPING) TUNNELS NOT CONTAINING NATURAL OR SLUDGE GAS PIPING	■									

If building is enclosed.

Note: This bulletin contains only a general description of the products shown. While uses and performance capabilities are described, under no circumstances shall the products be used by untrained or unqualified individuals and not until the product instructions including any warnings or cautions provided have been thoroughly read and understood. Only they contain the complete and detailed information concerning proper use and care of these products.

MSA NORTH AMERICA ISO 9001 CERTIFIED Quality System

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