

The Hazards of Nitrogen Inert Gas in Purging vessels



Confined Spaces are inherently hazardous places of work and exist in many industries. In some industries, particularly the petroleum or oil/ gas industry, these are intentionally flooded with an inert gas to ensure the vapour space is too low to support combustion. Nitrogen is typically used, and this works well for controlling fire or explosion in the vessel, but produces a potential inhalation hazard.

Whilst Nitrogen in itself is not a hazardous gas (approximately 78% of the air we breathe is composed of Nitrogen), when used in processing for reducing fire/ explosion risk, it is in pretty much 100% concentration and leaves no room for Oxygen, the essential gas for supporting human life. Nitrogen is slightly lighter than air and will mix freely with air.

A vessel purged with Nitrogen will cause asphyxiation within seconds if it is entered without adequate protection, or if the exhaust gas from the vessel is inhaled.

Immediate human reactions to purge gas

The immediate reaction is marked by struggling for breath, and unconsciousness follows in a few seconds if the worker is not removed. There has been numerous cases where persons are exposed to exhausting inert gas and losing consciousness immediately from here there are 2 options:

1. The worker falls away from the inert gas into air which is safe, in which case typically the worker comes round within seconds.
2. The worker falls into the inert gas which results in fatality.

Case Study involving 2 worker fatalities from Inert Gas



A tragic accident occurred at the Valero Energy Corporation Refinery in Delaware City, Delaware, on November 5, 2005 during the overnight shift. The workers, employed by a contractor, were engaged in reinstalling a large pipe elbow on the top of a pressure vessel, called a hydrocracker reactor. The uninstalled pipe left an opening on a work platform 24 inches in diameter, surrounded by two-foot high steel bolts. The reactor was under a nitrogen purge.

The US Chemical Safety Board determined that after the workers discovered a roll of duct tape lying inside the reactor on a tray about five feet below the opening they decided to attempt to remove it with a long wire hook. Entering the vessel to retrieve the tape under Valero safe work rules would have required getting a specially equipped and trained crew because the vessel was a permit-required confined space as defined by OSHA. That would delay the elbow reassembly many hours, but the job was supposed to be completed by the end of the shift. Repeated attempts by one of the workers to remove the tape were unsuccessful. Subsequently, The CSB concluded that he most likely stepped over the bolts and sat on the narrow ledge around the opening, presumably to improve his chance of hooking and removing the tape.

The worker intentionally entered the reactor by lowering himself through the opening, intending to grab the tape and quickly climb back out with the aid of a co-worker standing on the platform. But the oxygen-depleted environment created by the nitrogen flow in the reactor quickly overcame him, either before he entered the vessel causing him to fall in or he lowered himself in, and then he collapsed.

Seeing his co-worker lying on the tray five feet down inside the reactor, a second worker quickly inserted a ladder through the opening and climbed inside. He too was overcome by the oxygen-depleted environment and also succumbed. Efforts by properly-equipped emergency responders to revive the men were unsuccessful and the men were declared dead at a hospital.



In the USA alone, the Chemical Safety Board also reported that there were over 80 workplace deaths between 1992 and 2002 due to nitrogen asphyxiation!

Protecting from Nitrogen purging

These are typical ways to protect from nitrogen when purging:

- Barrier and Sign inlet and any exhaust points on the vessel
- Use gas detection instruments when working around the exhaust gas areas
- Ensure that workers in the area are warned of the work
- Ensure that workers in close proximity or that might need to access to the area have been trained in Inert Gas hazards

What if a vessel has to be entered?

If the vessel has to be entered for work specialist breathing systems for life support, gas detection, communications and rescue equipment need to be used , together with trained operatives and management. Additionally good procedures need to be set up and enforced to make the guarantee the work is safe.

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