

Incident Title		Nitrogen Asphyxiation During Maintenance	
Incident Type		Asphyxiation	
Date		27 th March 1998	
Country		USA	
Location		Hahnville, LA	
Fatalities		Injuries	Cost
1		1	Unknown
Incident Description		<p>A manufacturing plant producing ethylene oxide (EO) by direct reaction of ethylene with oxygen (O₂) over a catalyst was undergoing a maintenance turnaround. A 1.2 m (48") diameter flanged O₂-feed mixer had been removed for thorough cleaning (grease or oil residues are incompatible with O₂). The open ends of the pipe formerly connected to the mixer had been covered with a clear plastic sheet to keep the pipe free of debris until the mixer was reinstated. Fresh catalyst had been loaded in the reactors and nitrogen (N₂) hoses had been connected to maintain them under an inert atmosphere to protect the moisture-sensitive catalyst and retard rust formation. The N₂ was being vented from the reactor-side of the opening where the mixer had been. Two workers were conducting ultra-violet (UV or "black light") inspection of the 1.2 m (48") diameter flanges at the two openings (UV makes organic materials glow). They successfully completed inspection of the first (recycle gas-side) flange and then placed a black plastic sheet over the second (reactor-side) opening to provide shade to aid conducting UV inspection of the flange in bright daylight. While working just outside the pipe opening and inside the black plastic sheet, the 2 workers were overcome by N₂. One worker died from asphyxiation. The other survived but was severely injured.</p>	
 <p>Credit: US Chemical Safety Board</p>			
Incident Analysis		<p>Basic cause of both casualties was deprivation of oxygen (O₂).</p> <p>Critical factors included: 1) N₂ hoses had been connected to reactor inlet piping the previous night at a remote location not visible from the workface, 2) The black plastic sheet placed over the open-ended pipe inadvertently created a confined space, 3) N₂ gas is invisible, odourless and tasteless, 4) Absence of confined space entry permit and O₂ monitoring at workface.</p> <p>Root causes included: 1) Inadequate management of change (N₂ blanketing of reactors is abnormal operation), 2) Inadequate process isolation (reactor inlet valves were bypassed allowing N₂ to vent via process piping instead of reactor vents), 3) Inadequate control of work (absence of procedures for use of temporary enclosures and confined space entry permit), 4) Inadequate hazard awareness (no warning signs identifying pipe as confined space and alerting workers to presence of N₂ and potentially O₂-deficient atmosphere).</p>	
Lessons Learned		<p>1) Nitrogen (N₂) is a colourless, odourless, tasteless, non-irritant gas at ambient conditions and can displace oxygen (O₂) in air.</p> <p>2) Deprivation of oxygen can cause impaired perception and judgement, dizziness, nausea, loss of consciousness, coma, respiratory failure or death, depending on the extent of oxygen deficiency and duration of exposure.</p> <p>3) Warning signs should be posted on any process equipment or piping being purged with nitrogen to alert personnel to the potential presence of a life-threatening O₂-deficient atmosphere (especially in confined spaces).</p> <p>4) All access and egress points around process equipment or piping being purged with nitrogen should be barricaded and an access control system should be set up to log all personnel entering/leaving the barricaded area.</p> <p>5) All personnel entering the barricaded area should wear a personal gas monitor with an audible and visible alarm set at 19% O₂ concentration.</p>	
More Information		<p>1) "Nitrogen Asphyxiation", Summary Report of the US Chemical Safety and Hazard Investigation Board (CSB), Report No. 98-05-I-LA.</p> <p>2) "Hazards of Nitrogen and Catalyst Handling", BP Process Safety Series, 6th Edition, IChemE (2006), ISBN: 978-0-85295-540-6.</p>	
Industry Sector		Process Type	Incident Type
Petrochemicals		Ethylene Oxide	Asphyxiation
Equipment Category		Equipment Class	Equipment Type
Not equipment-related		Not applicable	Not applicable