


<b>Incident Title</b>		<b>Nitrogen Asphyxiation During Maintenance</b>	
<b>Incident Type</b>		Asphyxiation	
<b>Date</b>		27 <sup>th</sup> March 1998	
<b>Country</b>		USA	
<b>Location</b>		Hahnville, LA	
<b>Fatalities</b>		<b>Injuries</b>	<b>Cost</b>
1		1	Unknown
<b>Incident Description</b>		<p>A manufacturing plant producing ethylene oxide (EO) by direct reaction of ethylene with oxygen (O<sub>2</sub>) over a catalyst was undergoing a maintenance turnaround. A 1.2 m (48") diameter flanged O<sub>2</sub>-feed mixer had been removed for thorough cleaning (grease or oil residues are incompatible with O<sub>2</sub>). 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 (N<sub>2</sub>) hoses had been connected to maintain them under an inert atmosphere to protect the moisture-sensitive catalyst and retard rust formation. The N<sub>2</sub> 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 N<sub>2</sub>. One worker died from asphyxiation. The other survived but was severely injured.</p>	
 <p>Credit: US Chemical Safety Board</p>			
<b>Incident Analysis</b>		<p><b>Basic cause</b> of both casualties was deprivation of oxygen (O<sub>2</sub>).</p> <p><b>Critical factors</b> included: 1) N<sub>2</sub> 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) N<sub>2</sub> gas is invisible, odourless and tasteless, 4) Absence of confined space entry permit and O<sub>2</sub> monitoring at workface.</p> <p><b>Root causes</b> included: 1) Inadequate management of change (N<sub>2</sub> blanketing of reactors is abnormal operation), 2) Inadequate process isolation (reactor inlet valves were bypassed allowing N<sub>2</sub> 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 N<sub>2</sub> and potentially O<sub>2</sub>-deficient atmosphere).</p>	
<b>Lessons Learned</b>		<p>1) Nitrogen (N<sub>2</sub>) is a colourless, odourless, tasteless, non-irritant gas at ambient conditions and can displace oxygen (O<sub>2</sub>) 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 O<sub>2</sub>-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% O<sub>2</sub> concentration.</p>	
<b>More Information</b>		<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, 6<sup>th</sup> Edition, IChemE (2006), ISBN: 978-0-85295-540-6.</p>	
<b>Industry Sector</b>		<b>Process Type</b>	<b>Incident Type</b>
Petrochemicals		Ethylene Oxide	Asphyxiation
<b>Equipment Category</b>		<b>Equipment Class</b>	<b>Equipment Type</b>
Not equipment-related		Not applicable	Not applicable