The Dangers of Nitrogen ($N_2$)!
\( N_2 \) Hazards

Objectives:

• Understand the characteristics and health hazards pertaining to Nitrogen.

• Know the first-aid measures for treating victims of Nitrogen exposure.
Confined Space Injury and Fatality:

Two workers at a Union Carbide plant in Louisiana were inspecting a flange surface on a 48” diameter pipe using a black light to detect residual organic chemicals. They draped black plastic over the end of the pipe to create shade so the black light would illuminate surface deposits.

The workers were unaware that some 50m away, $N_2$ was being injected into the system to protect new catalyst from exposure to moisture.
When the two men entered the black cover, they quickly lost consciousness from lack of oxygen. A passerby noticed an arm sticking out from the plastic and immediately called for help.
**Confined Space Injury and Fatality (continued):**

One man died, and the other was seriously injured.

Incidentally, one of the victim’s had helped start the $N_2$ purge on the system the day before.
Confined Space Fatality:

In the early morning hours of his shift, a BP refinery employee was performing a gas test at the top manhole of a reactor while the equipment was being purged with $N_2$ for catalyst unloading.

The employee was found dead in the bottom of the reactor vessel. The $N_2$ purge had reduced the oxygen concentration near the manhole to dangerously low levels.
While it is widely known that exposure to excessive amounts of $N_2$ inside purged equipment can result in swift death, the fact that people can be equally affected while standing near openings of $N_2$ purged equipment may be less understood. This situation must not be underestimated!
Our success working around Nitrogen will have much to do with the way we treat Nitrogen. It is considered non-hazardous, it is listed along with other utilities on some sites, thus we can often be lulled into a false sense of security and complacency. As a gas, nitrogen is a “silent-killer” (as noted by the effects on the body due to a lack of adequate ventilation).

Because of the many recent Nitrogen exposures incidents in the chemical industry, we want to ensure that everyone understands the hazards and effects of exposure.
Nitrogen: an introduction

Nitrogen is a nontoxic, odorless, colorless, tasteless non-flammable gas. 78% (by volume) of the air we breathe is nitrogen. Oxygen constitutes approximately 21%. When Nitrogen concentrations increase (e.g., when purging equipment) and the oxygen levels drop below 19.5%, rapid suffocation can occur.

While some chemicals or substances may effect some of us to a greater degree than it will others based on our tolerance to the substance, Nitrogen will not. Nitrogen will effect every individual the same way: it displaces oxygen. Without enough oxygen, we die.
Nitrogen: an introduction (cont.)

Discovered in 1772, nitrogen is non-detectable by any of the human senses (no smell, no taste, invisible, no sound, no feeling). Nitrogen is non-flammable and weighs approximately the same as air.

Inhalation of a Nitrogen enriched atmosphere (ie: loss of oxygen) may cause dizziness, drowsiness, nausea, vomiting, excess salivation, diminished mental alertness, loss of consciousness, and ultimately: death.
**Health Information**

Nitrogen gas is classified as a “simple asphyxiant”. This means Nitrogen will displace oxygen and create oxygen deficient (<19.5%) atmospheres without significant physiologic effects.

Exposure limits are not normally given to “simple asphyxiants” because the limiting factor is the available oxygen. Therefore, Nitrogen has no exposure limit.

In addition to being an inhalation hazard, Liquid Nitrogen is a colorless, odorless, and extremely cold liquid (-200 DegC). Contact with this liquid or the cold vapors can cause severe frostbite.
What Makes Us Breathe?

Breathing is stimulated and controlled by carbon dioxide (\(\text{CO}_2\)) present in the lungs. As the \(\text{CO}_2\) level increases, the brain sends a message to increase respiration. When the \(\text{CO}_2\) level drops, the rate of respiration will also decrease in order to maintain the proper balance.

Everyone should understand that one deep breath of 100% \(\text{N}_2\) will be fatal. 100% \(\text{N}_2\) will displace \(\text{CO}_2\) and \(\text{O}_2\) completely. And, in the absence of a \(\text{CO}_2\) signal to the brain, the stimulus to breathe no longer exists! You will stop breathing!!
<table>
<thead>
<tr>
<th>Oxygen Content (Volume %)</th>
<th>Effects and Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>21%</td>
<td>Normal breathing.</td>
</tr>
<tr>
<td>17%</td>
<td>A candle is extinguished. Vision may be impaired.</td>
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<tr>
<td>12 - 16%</td>
<td>Labored breathing, increased heart rate. Lack of attention and coordination.</td>
</tr>
<tr>
<td>11 - 14%</td>
<td>Unable to think. No longer perceives danger. Ability to self rescue is impaired. Fatigue, injury to heart, fainting.</td>
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<tr>
<td>8 - 11%</td>
<td>Fainting without warning. Nausea, vomiting, unable to stand, walk or crawl. Person is dying but does not care. It's all quite painless.</td>
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<tr>
<td>6 - 8%</td>
<td>Faint almost immediately, heart may continue beating for a few minutes, resuscitation possible if immediate.</td>
</tr>
<tr>
<td>0 - 6%</td>
<td>Fainting, almost immediate coma, convulsions, respiratory arrest, death. Brain damage even if resuscitated.</td>
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First-Aid Measures

Nitrogen Inhalation:

• Call for help and remove victims to fresh air as quickly as possible. BUT: make sure, YOU are protected!

• Obtain help from trained personnel immediately.

• If not breathing, trained personnel should administer supplemental oxygen and/or cardio-pulmonary resuscitation (CPR), if necessary.