



**EIGA**

# *Training* **Package**

**TP N° 12/05**

## **Fire Hazards of Oxygen Enriched Atmospheres**

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# Properties of oxygen

## → Oxygen supports life

- ✓ **Oxygen is essential to life**
- Its normal concentration in the air we breathe is approximately 21 %
- We can breathe in a 50-60% oxygen enriched atmosphere for several hours under medical care (oxygen therapy)
- **But it is dangerous to do so without knowing the associated risks due to oxygen enrichment !**



# Properties of oxygen

## → Oxygen supports combustion

- It is not flammable but supports combustion.
- **Most materials burn fiercely sometimes explosively in oxygen !**
- As the oxygen concentration in air increases, the potential fire risk increases.
- At concentrations above 23 % in air, the situation becomes dangerous due to the increased fire hazard.



*This van caught fire very quickly, due to the driver smoking in an oxygen enriched atmosphere.*

## Properties of oxygen

→ Oxygen gives no warning

- Oxygen is **colourless**, **odourless** and **tasteless**

→ **Oxygen enrichment cannot be detected by the human senses !**



# Properties of oxygen

## Oxygen is heavier than air

Being heavier than air, oxygen can **accumulate** in low lying areas !

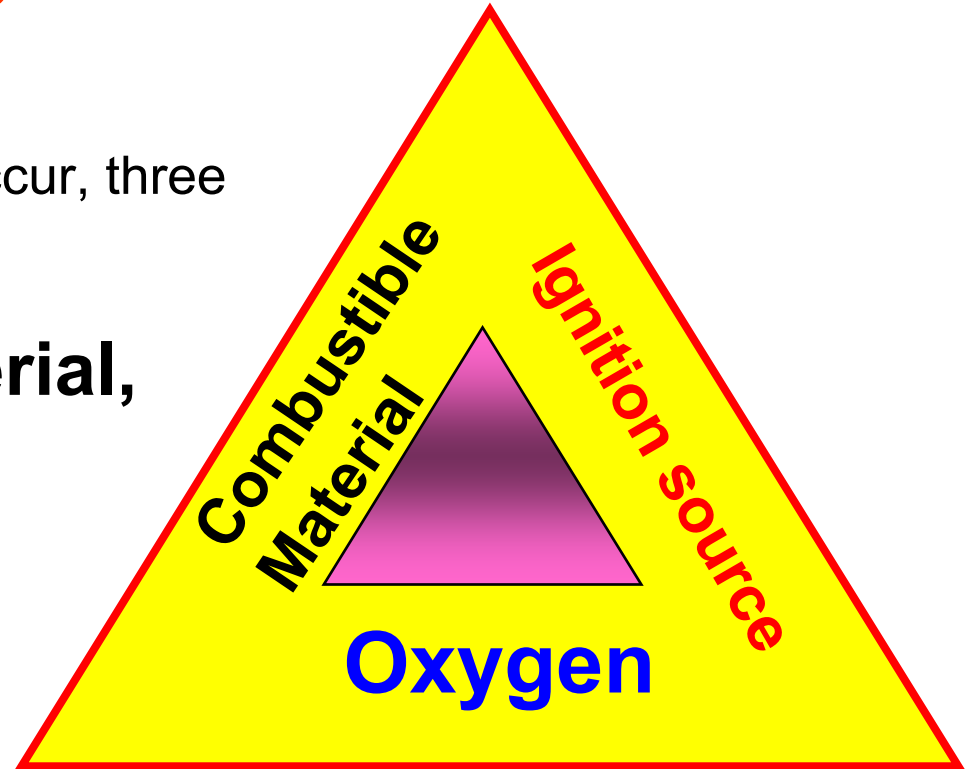
- such as pits or underground rooms,
- especially in cases of liquid spillage.



# Necessary conditions for a fire

For a fire or explosion to occur, three elements are required:

- ✓ **Combustible material,**
- ✓ **Oxygen** and an
- ✓ **Ignition source**



**When one of the 3 elements is missing,  
a fire cannot occur!**



# Oxygen...





# Leaking equipment is very dangerous

- Leaks lead to an oxygen enrichment hazard
- Leaking connections, flanges, fittings are hazardous.
- Insufficient ventilation increases the risk
- Leak test all equipment after assembly or maintenance



# Liquid Oxygen Spill

- A spill of liquid oxygen creates a dense cloud of oxygen enriched air as it evaporates.
- The clothing of personnel entering the cloud will become enriched with oxygen.
- When liquid oxygen impregnates the soil which contains organic material, e.g. wood, asphalt, etc., a dangerous situation exists, as the organic material is liable to explode when impacted.





# Combustible materials...



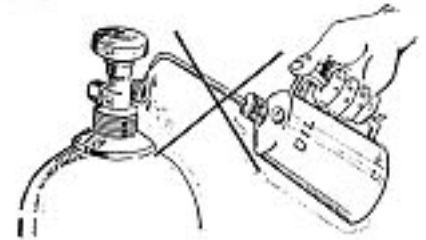
# Compatibility of materials

- Only certain materials are suitable for use in oxygen service
- Most materials - including metals - will burn in oxygen enriched atmospheres
- Equipment and material contaminated with oil or grease can ignite easily and burn with explosive violence in oxygen enriched atmospheres



# Never use oil or grease to lubricate oxygen equipment!

- Equipment must be cleaned for oxygen service using approved cleaning agents/methods



- Check that any material/part or substance you intend to use is approved for oxygen service.

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**Ignition sources...**



# Causes of oxygen fires

- Impact with combustible material impregnated with oxygen
- Improper use of oxygen
- Incorrect operation and maintenance of oxygen systems
- Use of materials non compatible with oxygen service



*This oxygen trailer was damaged and persons were killed after oxygen impregnated asphalt exploded.*

*The ignition was caused by the impact of a hook on the road.*

# Do not use oxygen for applications for which it is not intended!

Do not use oxygen as a substitute for air:

- Powering pneumatic tools
- Inflating tyres
- Starting diesel engines
- Dusting benches, machinery or clothing





# No flame in oxygen enriched atmospheres

- DO NOT SMOKE or use naked flames!
- Oxygen enriched atmosphere can occur at:
  - Pits, trenches,
  - Low enclosed areas
  - Underground sewers
  - In air separation units, cylinder filling plants,...
  - Around tanker filling
  - Around vents, leaks...



# No hot work before checking atmosphere



- If hot work (welding, flame cutting, soldering, grinding, etc.) has to be carried out, ensure that:
  - the atmosphere has been checked and confirmed as safe
- Don't start work without a Work Permit

Any attached document or log sheet ?		<input type="checkbox"/> YES	<input type="checkbox"/> NO	HOW MANY .....			
List of attached documents .....							
<b>1. WORK ACTIVITY</b>							
Plant / Unit : .....							
Description of work to be done : .....							
Permit valid from .....		Hours/date	To : .....	Hours/date			
Have all relevant departments/personnel been consulted ?		<input type="checkbox"/> YES	<input type="checkbox"/> NOT APPLICABLE				
<b>2. POTENTIAL HAZARDS &amp; HAZARDOUS JOBS</b>							
		YES	NO			YES	NO
. Jobs performed by contractors or temporary workers		<input type="checkbox"/>	<input type="checkbox"/>	. Maintenance or repairs in areas, or to equipment or lines, containing or supposed to contain hazardous materials or cond		<input type="checkbox"/>	<input type="checkbox"/>
. Potential oxygen deficiency or enrichment		<input type="checkbox"/>	<input type="checkbox"/>	. Manual or powered excavations		<input type="checkbox"/>	<input type="checkbox"/>
. Potential flammable / explosive atmosphere		<input type="checkbox"/>	<input type="checkbox"/>	. Use of mobile cranes		<input type="checkbox"/>	<input type="checkbox"/>
. Potential high temperature / pressure		<input type="checkbox"/>	<input type="checkbox"/>	. Insulation or catalyst handling		<input type="checkbox"/>	<input type="checkbox"/>
. Potential exposure to hazardous chemicals (toxic, reactive acid, caustic...)		<input type="checkbox"/>	<input type="checkbox"/>	. Use of adaptors		<input type="checkbox"/>	<input type="checkbox"/>
. Confined space entry		<input type="checkbox"/>	<input type="checkbox"/>	. Product conversion of stationary or mobile or portable vessels and containers		<input type="checkbox"/>	<input type="checkbox"/>
. Bypassing or removing/altering safety devices and equip		<input type="checkbox"/>	<input type="checkbox"/>	. Temporary or permanent changes, alterations, modifications of equipment or processes		<input type="checkbox"/>	<input type="checkbox"/>
. Elevated work		<input type="checkbox"/>	<input type="checkbox"/>	. Exposure to traffic (road, rail)		<input type="checkbox"/>	<input type="checkbox"/>
. Introduction of ignition sources where not permanently allowed (fire permit)		<input type="checkbox"/>	<input type="checkbox"/>	. Exposure to moving / rotating machinery		<input type="checkbox"/>	<input type="checkbox"/>
. Electrical troubleshooting or repair on live circuits		<input type="checkbox"/>	<input type="checkbox"/>				
Others (state) .....							
<b>3. SAFETY PRECAUTIONS</b>							
		YES	NO			YES	NO
. Draining		<input type="checkbox"/>	<input type="checkbox"/>	. Remove hazardous materials		<input type="checkbox"/>	<input type="checkbox"/>
. Depressurising		<input type="checkbox"/>	<input type="checkbox"/>	. Fresh air ventilation		<input type="checkbox"/>	<input type="checkbox"/>
. Physical Isolation		<input type="checkbox"/>	<input type="checkbox"/>	. Atmosphere analysis :		<input type="checkbox"/>	<input type="checkbox"/>
. Electrical Isolation		<input type="checkbox"/>	<input type="checkbox"/>	. Oxygen		<input type="checkbox"/>	<input type="checkbox"/>
. Safety tags and locks		<input type="checkbox"/>	<input type="checkbox"/>	. Flammable		<input type="checkbox"/>	<input type="checkbox"/>
. Flushing with water/solvent		<input type="checkbox"/>	<input type="checkbox"/>	. Toxic		<input type="checkbox"/>	<input type="checkbox"/>
. Steaming out		<input type="checkbox"/>	<input type="checkbox"/>	. Other		<input type="checkbox"/>	<input type="checkbox"/>
. Purging with inert gas/air		<input type="checkbox"/>	<input type="checkbox"/>	. Area marked off		<input type="checkbox"/>	<input type="checkbox"/>
. Temperature normalisation		<input type="checkbox"/>	<input type="checkbox"/>	. Warning notices		<input type="checkbox"/>	<input type="checkbox"/>
Standby man		<input type="checkbox"/>	<input type="checkbox"/>	Elevated work		<input type="checkbox"/>	<input type="checkbox"/>
Contractors trained		<input type="checkbox"/>	<input type="checkbox"/>	Eliminate ignition sources		<input type="checkbox"/>	<input type="checkbox"/>
Fire hose		<input type="checkbox"/>	<input type="checkbox"/>	Fire screen		<input type="checkbox"/>	<input type="checkbox"/>
Wet surrounding area		<input type="checkbox"/>	<input type="checkbox"/>	Audible/Visible warnings		<input type="checkbox"/>	<input type="checkbox"/>
Clear area of combustible		<input type="checkbox"/>	<input type="checkbox"/>	Fire extinguishers		<input type="checkbox"/>	<input type="checkbox"/>
Others (state) .....							
Type : .....							
<b>4. PERSONNEL PROTECTION</b>							
		YES	NO			YES	NO
. Head		<input type="checkbox"/>	<input type="checkbox"/>	. Ears		<input type="checkbox"/>	<input type="checkbox"/>
. Face		<input type="checkbox"/>	<input type="checkbox"/>	. Hands		<input type="checkbox"/>	<input type="checkbox"/>
. Eyes		<input type="checkbox"/>	<input type="checkbox"/>	. Feet		<input type="checkbox"/>	<input type="checkbox"/>
Body		<input type="checkbox"/>	<input type="checkbox"/>	Breathing		<input type="checkbox"/>	<input type="checkbox"/>
Others		<input type="checkbox"/>	<input type="checkbox"/>				
State Special Requirements : .....							
<b>5. WORK AUTHORISATION</b>							
Issuer : This certifies that I have consulted all relevant departments/personnel, discussed the scope of work, inspected the preparatory work and the work area covered by this Work Permit. I therefore confirm that the work, as detailed in Section 1, can be carried out.							
Name : .....				Signature : .....			
Person responsible for work : The successive steps of the work, the potential hazards and the safety precautions have been explained and understood.							
Name / Company : .....				Signature : .....			
<b>6. CLOSING</b>							

# If exposed to an oxygen enriched atmosphere

Ventilate your clothing in the open air for at least 15 minutes before smoking or going near a source of ignition.



# Fire Hazards of Oxygen Enriched Atmospheres

*Work safely !*  
*It is your life!*

