A large, intense fire with bright orange and yellow flames against a blue sky. In the foreground, a white fire helmet is visible on the right side. The text is overlaid on this image.

Self Contained Breathing Apparatus

Part 1

A large, intense fire with bright orange and yellow flames against a blue sky. In the foreground, a white fire helmet is visible, slightly out of focus. The overall scene is dramatic and emphasizes the need for respiratory protection.

Objectives

- Identify the development of the SCBA
- Identify the hazardous environments requiring the use of respiratory protection
- Identify the physical requirements of the SCBA user
- Identify the uses and limitations of the SCBA
- Identify the components, functions and safety features of SCBA



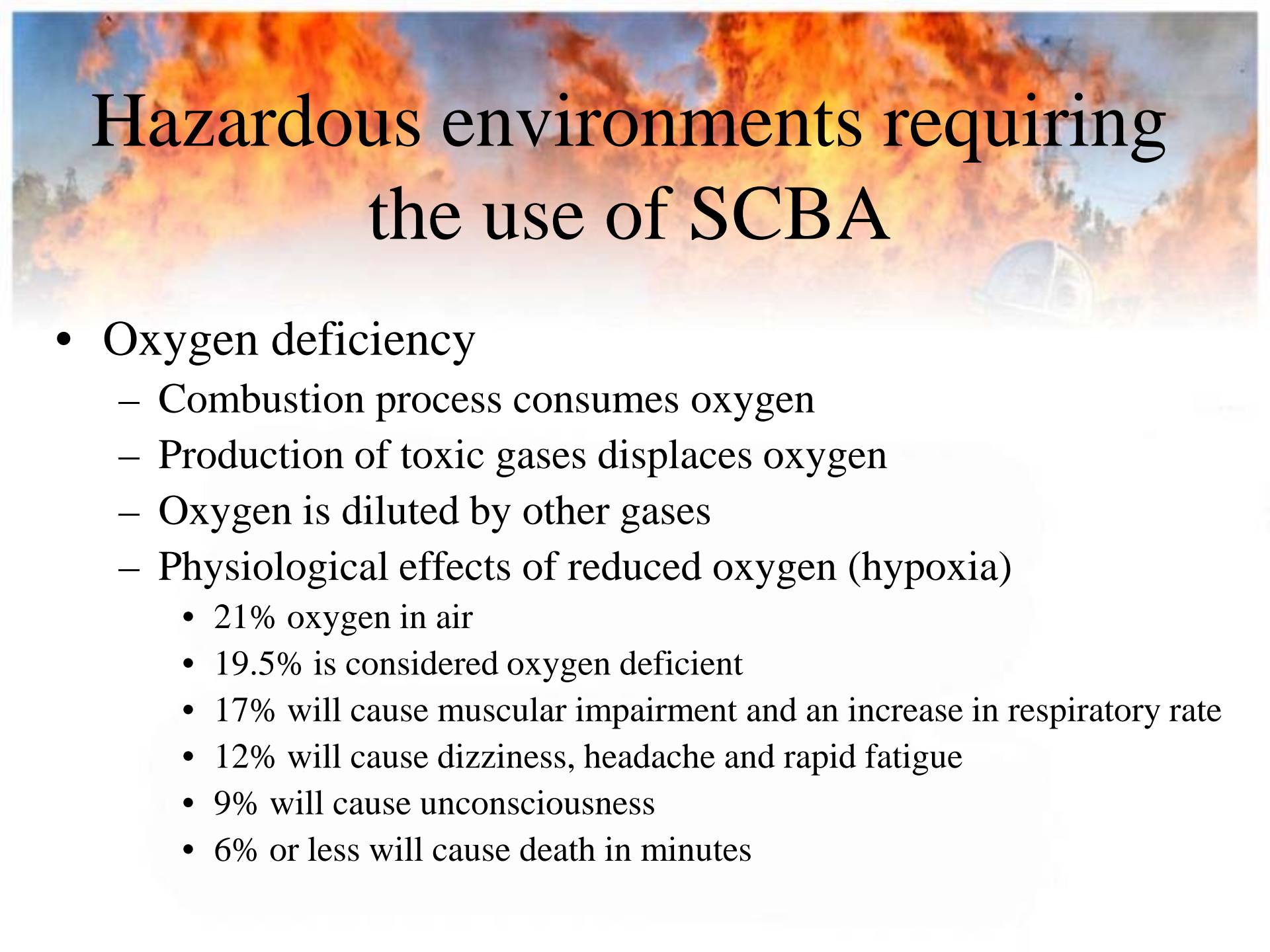
Development of the SCBA

- Firemen would dip their long beards in water and use it as a filter
- In 1823 John and Charles Deane patented a smoke helmet that was fed with fresh air
- In 1863 A. Lacour invented a SCBA of sorts, consisting of an airtight bag made of canvas and rubber
- In the 1890s and early 1900s the Vajen-Bader Co. produced a “Smoke Protector” which sealed off the wearer’s head and supplied air from a compressed-air cylinder

A large fire with a fire helmet in the foreground. The fire is intense, with bright orange and yellow flames rising against a blue sky. A fire helmet is visible in the lower right corner of the image.

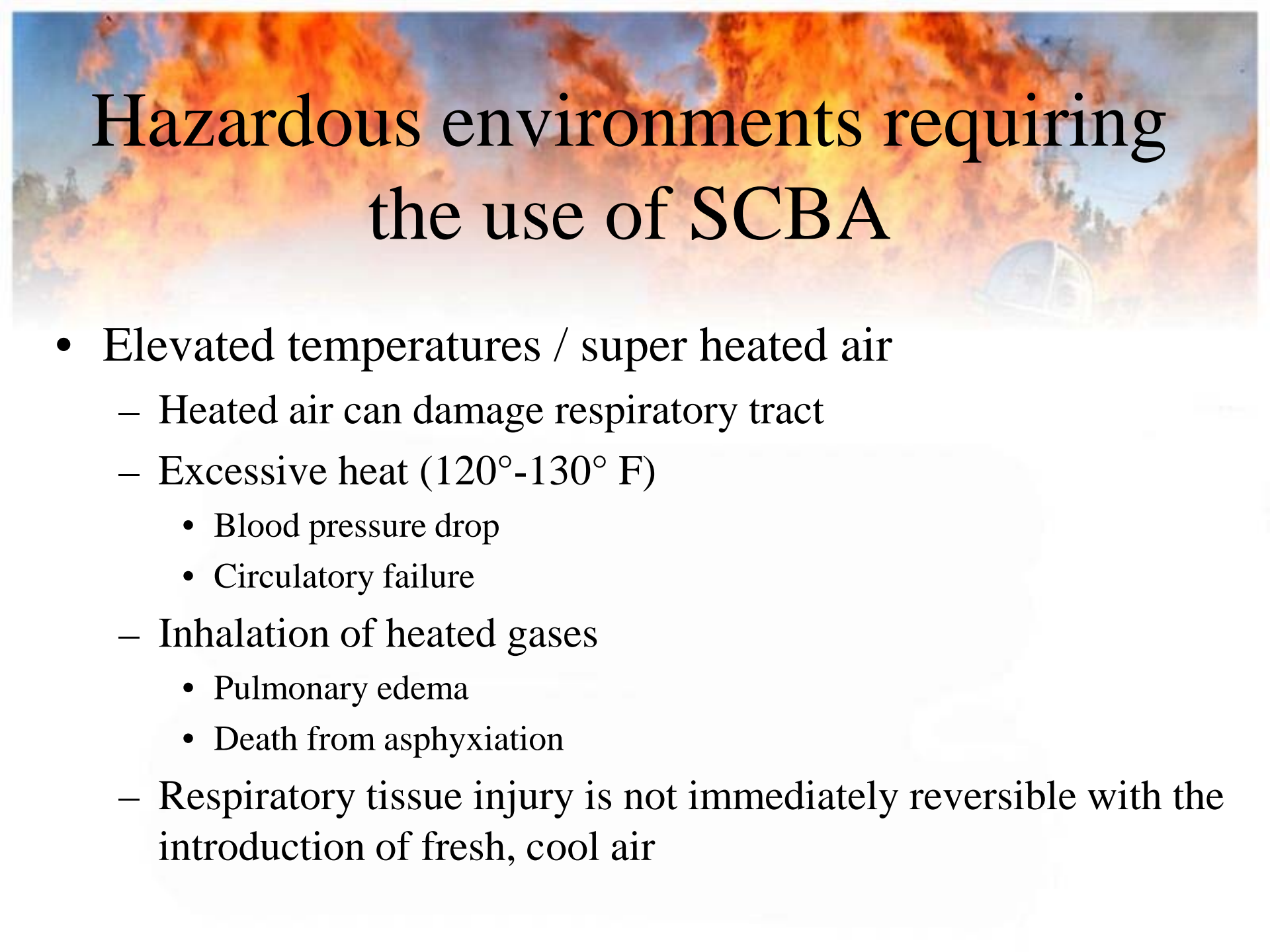
Hazardous environments requiring the use of SCBA

- Oxygen deficiency
- Elevated temperatures / super heated air
- Smoke
- Toxic gases

A large fire with a fire helmet in the foreground. The fire is bright orange and yellow, filling most of the background. In the foreground, a white fire helmet is visible on the right side. The text is overlaid on the fire.


Hazardous environments requiring the use of SCBA

- Oxygen deficiency
 - Combustion process consumes oxygen
 - Production of toxic gases displaces oxygen
 - Oxygen is diluted by other gases
 - Physiological effects of reduced oxygen (hypoxia)
 - 21% oxygen in air
 - 19.5% is considered oxygen deficient
 - 17% will cause muscular impairment and an increase in respiratory rate
 - 12% will cause dizziness, headache and rapid fatigue
 - 9% will cause unconsciousness
 - 6% or less will cause death in minutes

A large fire with a fire helmet in the foreground. The fire is intense and bright orange and yellow, filling most of the upper half of the image. In the foreground, a white fire helmet is visible, slightly out of focus. The background shows some trees and a blue sky.


Hazardous environments requiring the use of SCBA

- Elevated temperatures / super heated air
 - Heated air can damage respiratory tract
 - Excessive heat (120°-130° F)
 - Blood pressure drop
 - Circulatory failure
 - Inhalation of heated gases
 - Pulmonary edema
 - Death from asphyxiation
 - Respiratory tissue injury is not immediately reversible with the introduction of fresh, cool air

A large fire with a fire helmet in the foreground. The fire is intense and orange, filling the upper half of the image. A fire helmet is visible in the lower right corner, partially obscured by the fire's glow.


Hazardous environments requiring the use of SCBA

- Smoke
 - Product of incomplete combustion
 - Suspended particles provide a means for the condensation of some of the gaseous products of combustion
 - Some particles are only irritating while others are lethal
 - The size of the particle will determine how deeply it penetrates into the lungs

A large, intense fire with bright orange and yellow flames against a blue sky. In the foreground, a white fire helmet is visible, slightly out of focus. The overall scene is dramatic and emphasizes the danger of fire.

Hazardous environments requiring the use of SCBA

- Toxic gases
 - Every fire will present differing products of combustion
 - Combinations of gases may have a synergistic effect
 - May cause disease of the lung tissue
 - Impair the oxygen carrying capacity of red blood cells
 - Commonly found fire gases
 - Carbon monoxide
 - Hydrogen chloride
 - Hydrogen cyanide
 - Carbon dioxide
 - Nitrogen oxides
 - Phosgene

A large, intense fire with bright orange and yellow flames against a blue sky. In the foreground, a white fire helmet is visible, slightly out of focus. The overall scene is a hazardous environment.


Hazardous environments requiring the use of SCBA

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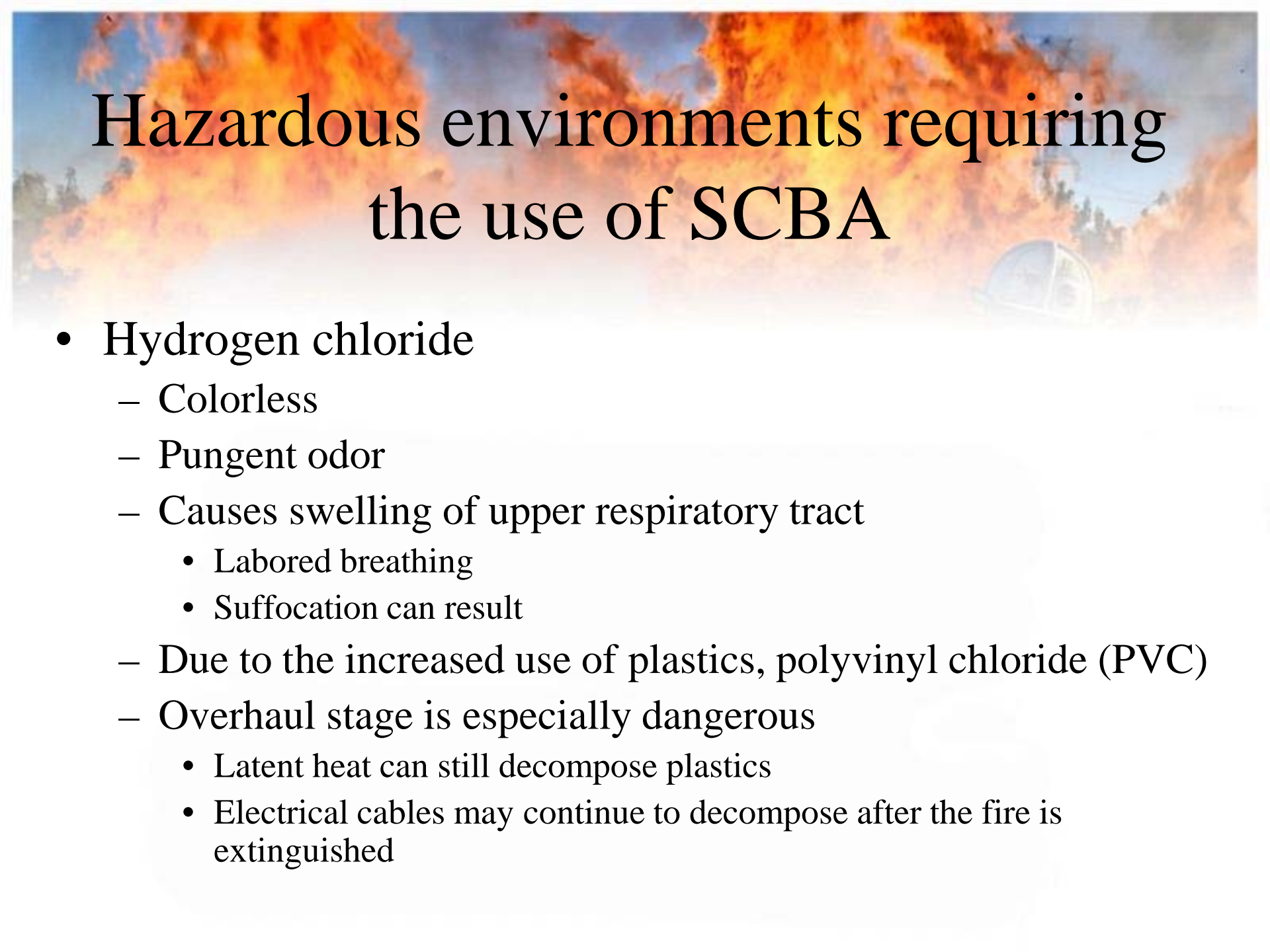
Hazardous environments requiring the use of SCBA

- Carbon monoxide
 - More fire deaths than any other product of combustion
 - Colorless
 - Odorless
 - Present at every fire
 - Results from incomplete combustion
 - Combines with hemoglobin about 200 times faster than oxygen causing oxygen to be excluded
 - Concentrations above five hundredths of one percent (0.05%) or 500 PPM can be dangerous

A large fire with a fire helmet in the foreground. The fire is intense and orange, filling the upper half of the image. A fire helmet is visible in the lower right foreground, partially obscured by the fire's glow.


Hazardous environments requiring the use of SCBA

- Carbon monoxide
 - Symptoms include
 - Headache
 - Dizziness
 - Nausea
 - Vomiting
 - Cherry-red skin coloration
 - Administering pure oxygen is most important for first aid
 - Brain injuries may appear up to three weeks after severe exposure

A large fire with a fire helmet in the foreground. The fire is intense and orange, filling the upper half of the image. A fire helmet is visible in the lower right foreground, partially obscured by the fire's glow. The background shows a blue sky and some trees.


Hazardous environments requiring the use of SCBA

- Hydrogen chloride
 - Colorless
 - Pungent odor
 - Causes swelling of upper respiratory tract
 - Labored breathing
 - Suffocation can result
 - Due to the increased use of plastics, polyvinyl chloride (PVC)
 - Overhaul stage is especially dangerous
 - Latent heat can still decompose plastics
 - Electrical cables may continue to decompose after the fire is extinguished

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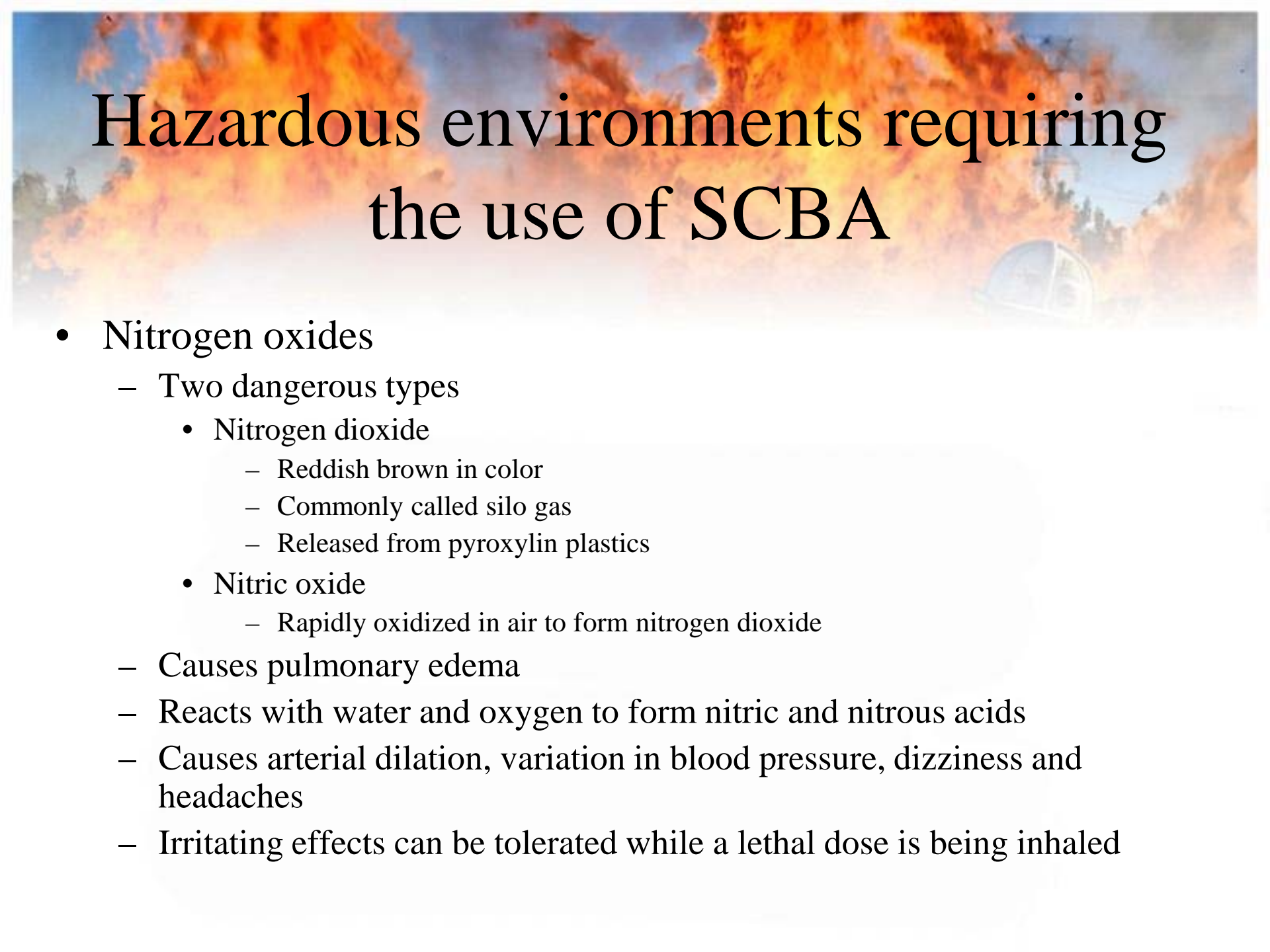
Hazardous environments requiring the use of SCBA

- Hydrogen cyanide
 - Colorless
 - Almond odor
 - Interferes with respiration at the cellular and tissue level
 - Classified as a chemical asphyxiate
 - Concentrations above 50 PPM are almost immediately fatal
 - Materials that emit hydrogen cyanide
 - Wool
 - Nylon
 - Polyurethane foam
 - Rubber
 - Paper

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Hazardous environments requiring the use of SCBA

- Carbon dioxide
 - Colorless
 - Odorless
 - Non-flammable
 - Concentrations greater than 10-12% cause death within a few minutes from paralysis of the brain's respiratory center
 - Use caution when working around a carbon dioxide total flooding system

A large fire with a fire helmet in the foreground. The fire is intense and orange-red, filling the upper half of the image. A fire helmet is visible in the lower right foreground, partially obscured by the fire's glow. The background shows a blue sky and some trees.

Hazardous environments requiring the use of SCBA

- Nitrogen oxides
 - Two dangerous types
 - Nitrogen dioxide
 - Reddish brown in color
 - Commonly called silo gas
 - Released from pyroxylin plastics
 - Nitric oxide
 - Rapidly oxidized in air to form nitrogen dioxide
 - Causes pulmonary edema
 - Reacts with water and oxygen to form nitric and nitrous acids
 - Causes arterial dilation, variation in blood pressure, dizziness and headaches
 - Irritating effects can be tolerated while a lethal dose is being inhaled

A large fire with a fire helmet in the foreground. The fire is intense and orange, with a fire helmet visible in the lower right corner. The background is a bright blue sky.

Hazardous environments requiring the use of SCBA

- Phosgene
 - Colorless
 - Tasteless
 - Disagreeable odor
 - Produced when freon comes into contact with flame
 - When in contact with water, it decomposes into hydrochloric acid
 - Concentrations above 25 PPM are hazardous



Requirements of the SCBA User

- Sound physical condition
 - Maximize amount of work that can be performed
 - Maximize available air supply
- Agility
 - Unit will restrict wearer's movements
 - Will affect balance
- Facial features
 - Need a good facepiece seal
 - Facial hair may not permit a proper facepiece seal

The background of the slide features a large, intense fire with bright orange and yellow flames against a blue sky. In the lower right foreground, a white fire helmet is visible, slightly out of focus.

Requirements of the SCBA User

- Medical
 - Good motor coordination needed
 - Must have good physical strength and size
 - Good cardiovascular system
 - Healthy respiratory system
- Mental
 - Adequate training in use of equipment
 - Self-confidence
 - Emotional stability

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Uses and Limitations of SCBA

- Limited visibility
- Decreased ability to communicate
- Increased weight
- Decreased mobility
- Limited air supply

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Uses and Limitations of SCBA

- Conservation of air
 - Always practice controlled breathing
 - When supply is low, you may practice skip breathing
 - Emergency breathing technique
 - Inform partner of low air and exit toxic atmosphere
 - Inhale, hold your breath as long as it would take to exhale, then inhale once again before exhaling
 - Exhale slowly to keep carbon dioxide in the lungs in the proper balance



Components, Functions and Safety Features of SCBA

- Open circuit SCBA

- Air cylinder assembly

- Main weight of the breathing apparatus
 - Many different cylinder pressures and capacities

- Low pressure 2216 PSI

- Contains 45 cubic feet of air
 - Rated as a 30 minute supply
 - Expected use of time 12 to 18 minutes

- Low pressure 3000 PSI

- Contains 66 cubic feet of air
 - Rated as a 45 minute supply

- High pressure 4500 PSI

- Contains 45 cubic feet of air
 - Rated as a 30 minute supply

- High pressure 4500 PSI

- Contains 87 to 90 cubic feet of air
 - Rated as a 60 minute supply



Components, Functions and Safety Features of SCBA

- Open circuit SCBA
 - Backpack and harness assembly
 - Designed to hold the air cylinder
 - Harness straps provide a secure fit
 - Waist strap is designed to distribute weight of cylinder
 - Regulator
 - Reduces the pressure to slightly above atmospheric pressure and controls the flow to meet needs of wearer
 - By-pass or purge valve is used as an emergency valve should regulator fail
 - Pressure gauge located in close proximity to face piece
 - Should read within 100 PSI of cylinder gauge
 - Audible low pressure / quarter service alarm

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Components, Functions and Safety Features of SCBA

- Open circuit SCBA
 - Face piece assembly
 - Lens
 - Exhalation valve / one way valve
 - Possibly a low pressure hose
 - Adjustable straps or webbing
 - Speaking diaphragm

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Components, Functions and Safety Features of SCBA

- Closed-circuit breathing apparatus
 - Not commonly used in the fire service
 - Sometimes used for hazmat or confined spaces
 - Air supply of 30 minutes to 4 hours
 - Contains a cylinder of oxygen, filter system and regulator valves
 - Filters and cleans exhaled breath and adds pure oxygen



Q & A