Weapons to waste

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Chemical Demilitarisation Branch

OPCW
Organisation for the Prohibition of Chemical Weapons

Definitions and obligations

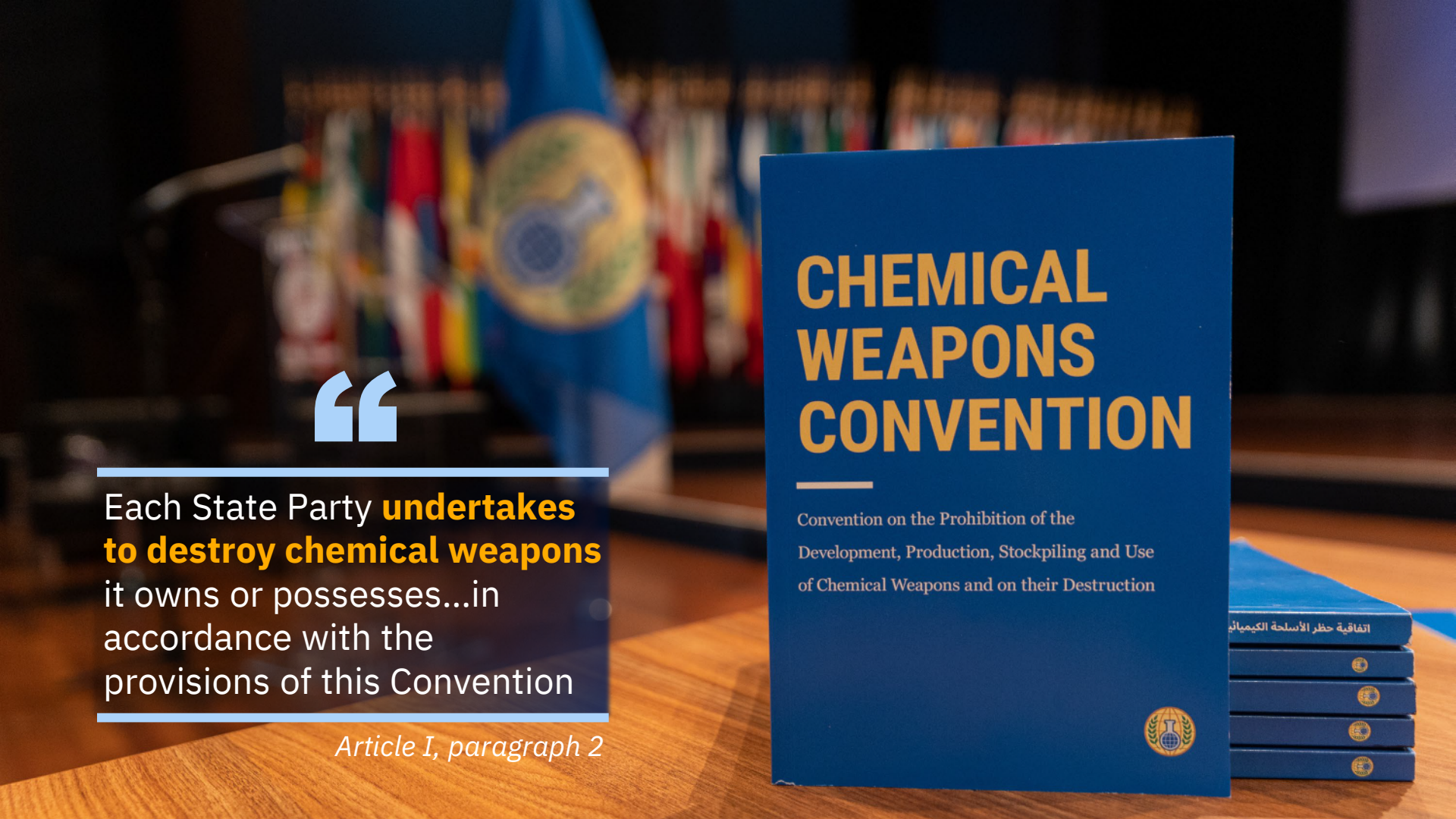
High-temperature destruction

Low-temperature destruction

Destroy a chemical weapon!

Remaining challenges

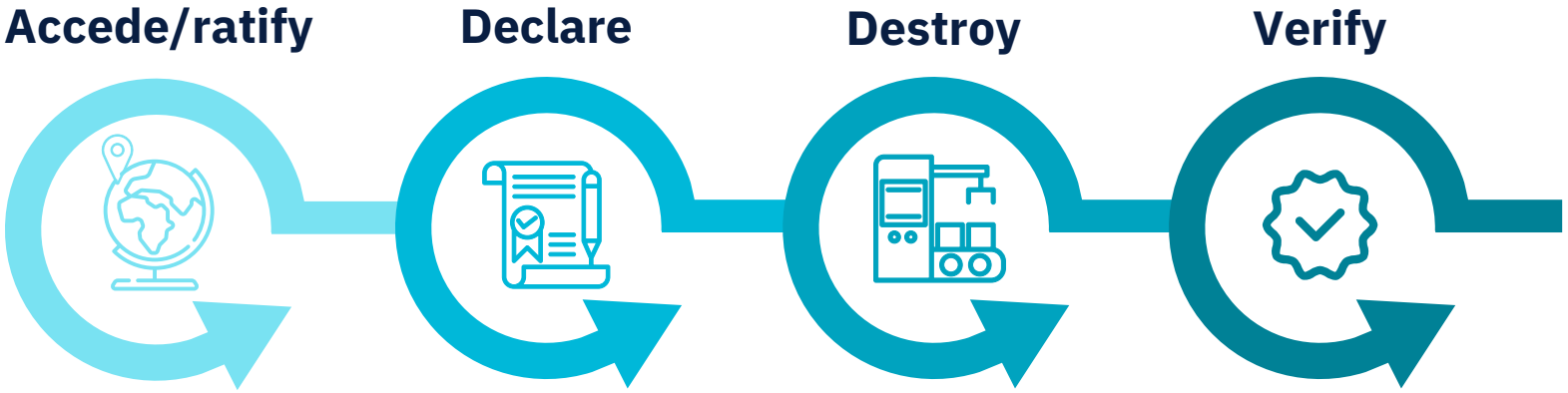
Knowledge test



Each State Party **undertakes to destroy chemical weapons** it owns or possesses...in accordance with the provisions of this Convention

Article I, paragraph 2

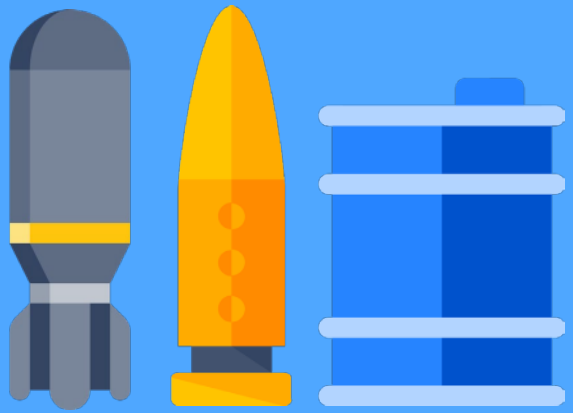
Destruction of chemical weapons



What is a chemical weapon?

Toxic chemicals and their precursors

Munitions and devices



Equipment

Chemical weapons-related declarations

Article III

- Chemical weapons
- Old chemical weapons
- Abandoned chemical weapons
- Chemical weapons production facilities
- Other chemical weapons-related facilities
- Riot control agents

Photo by Bethani Crouch, U.S. Army Chemical Materials Activity

The appearance of U.S. Department of Defense (DoW) visual information does not imply or constitute DoW endorsement.

Chemical weapons-related declarations

Article III, paragraph 1(a)

- Any chemical weapons owned/possessed
- Specify the location, quantity, and detailed inventory of chemical weapons
- Chemical weapons on its territory owned or possessed by another State
- Declare transfers/receipts of chemical weapons since 1 January 1946
- Provide its general plan for destruction

Photo by Bethani Crouch, U.S. Army Chemical Materials Activity

The appearance of U.S. Department of Defense (DoW) visual information does not imply or constitute DoW endorsement.

Destruction of chemical weapons

1

Chemicals are converted in an **irreversible** way to a form **unsuitable for production of chemical weapons**

2

Munitions and other devices are processed in an **irreversible** manner, **rendering them unusable**

Part IV (A), paragraph 12

Destruction requirements

Each State Party is responsible for determining how it will destroy its chemical weapons and bearing the costs

- Ensure personnel safety
- Protect the environment
- Comply with safety and emission standards
- Use an OPCW-verifiable process

Article IV, paragraphs 10 and 16; Part IV (A), paragraphs 13, 14, and 16

Destruction requirements

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- Protect the environment
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- Use an OPCW-verifiable process

Category 1
Based on Schedule 1 chemicals

Category 2
Based on other chemicals

Category 3
Unfilled munitions and devices, and equipment

Article IV, paragraphs 10 and 16; Part IV (A), paragraphs 13, 14, and 16

Destruction requirements

Each State Party is responsible for determining how it will destroy its chemical weapons and bearing the costs

- Ensure personnel safety
- Protect the environment
- Comply with safety and emission standards
- Use an OPCW-verifiable process

- Dumping in any body of water
- Land burial
- Open-pit burning

Article IV, paragraphs 10 and 16; Part IV (A), paragraphs 13, 14, and 16

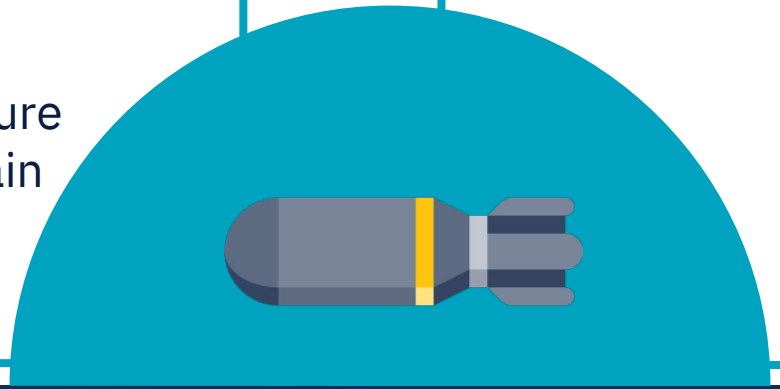
Additional considerations

Suitability
Selecting a technology to suit the types, conditions, and quantities of chemical weapons

Efficiency and effectiveness
Achieving complete and irreversible destruction of the chemical weapons

Technical feasibility
Availability of technical expertise and infrastructure to implement and maintain the technology

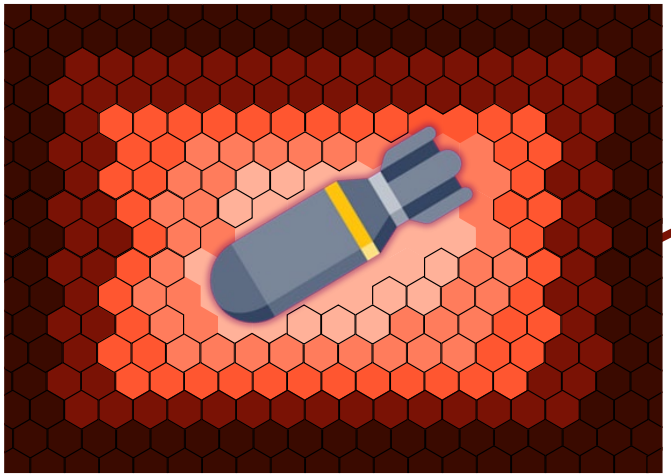
Cost
Both capital and ongoing operational costs should be cost-effective

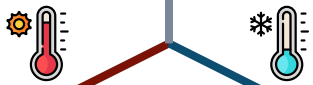


Destruction technologies

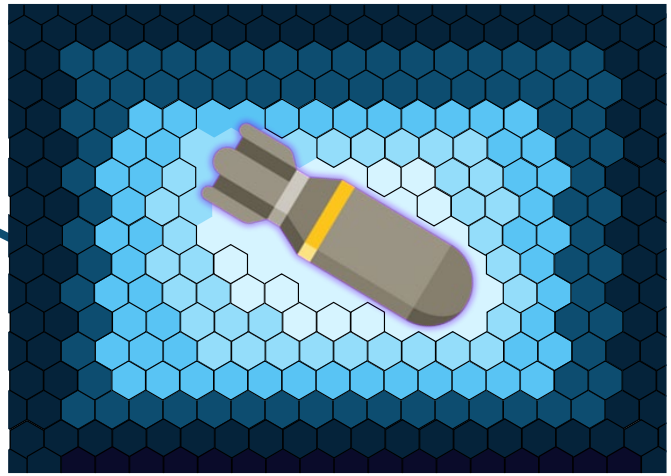
Catalyst

High-temperature methods





Low-temperature methods



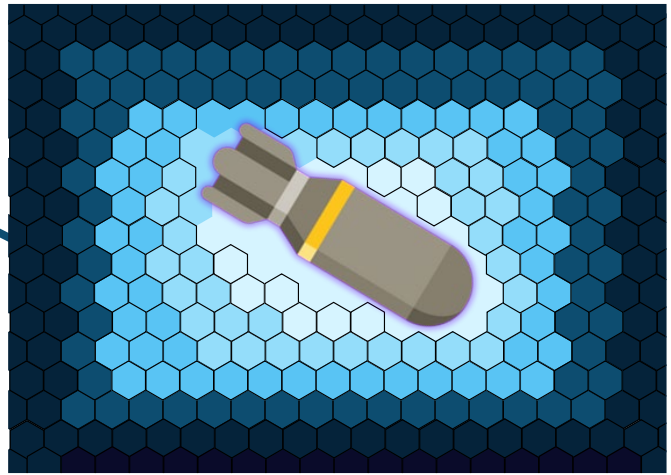
Destruction technologies

Catalyst

High-temperature methods

High temperatures ensure the complete breakdown of the chemicals to relatively harmless products

Low-temperature methods



Destruction technologies

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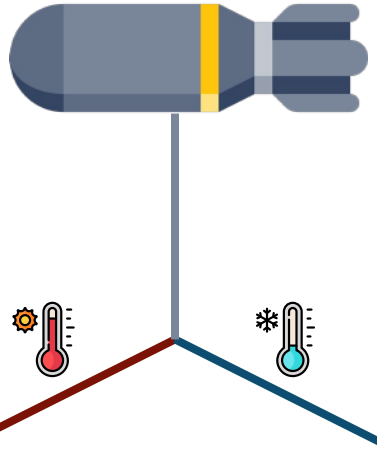

High-temperature methods

High temperatures ensure the complete breakdown of the chemicals to relatively harmless products

Low-temperature methods

Chemical warfare agents are reacted with other chemicals to form less toxic products

Destruction technologies

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High-temperature methods

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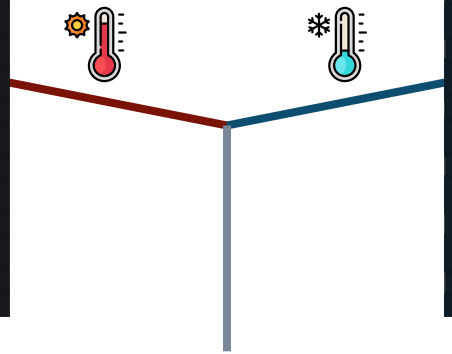
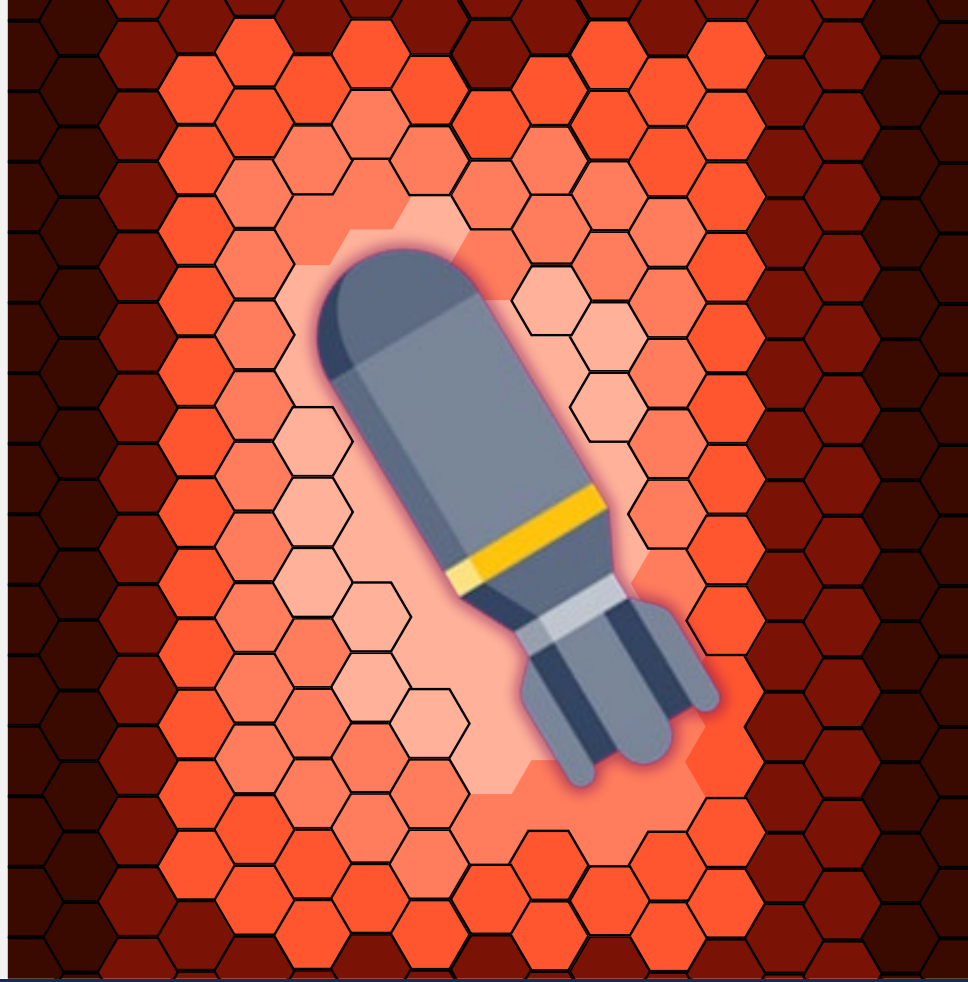


Low-temperature methods

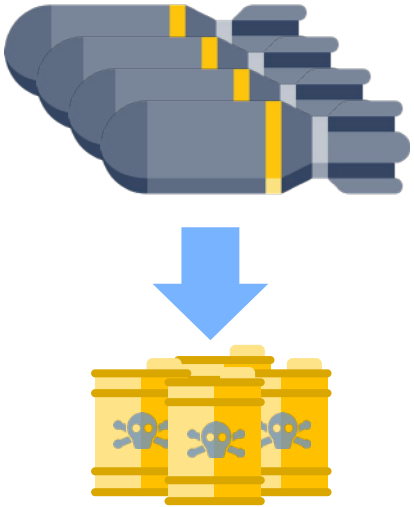
Chemical warfare agents are reacted with other chemicals to form less toxic products

Secondary treatment required
for complete detoxification

High-temperature methods



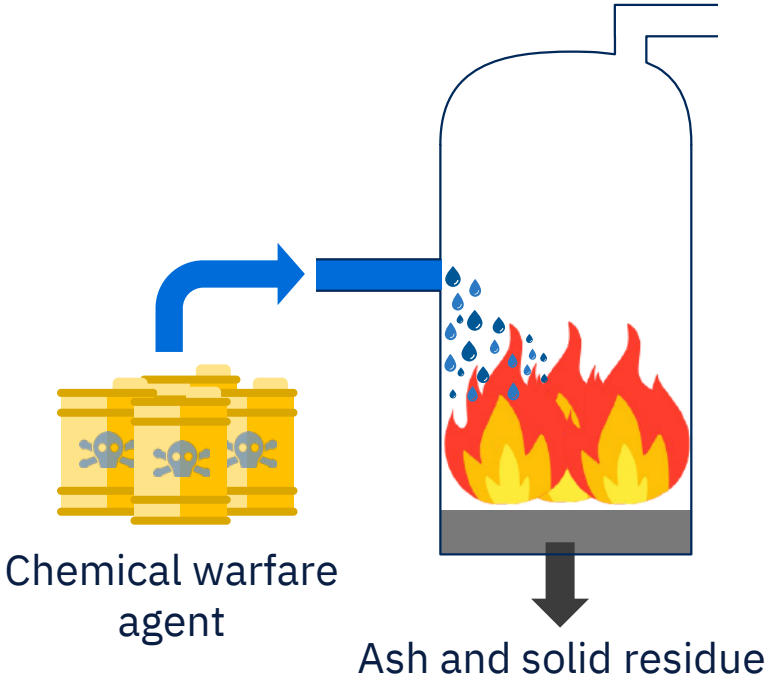
Incineration overview



Chemical warfare agent

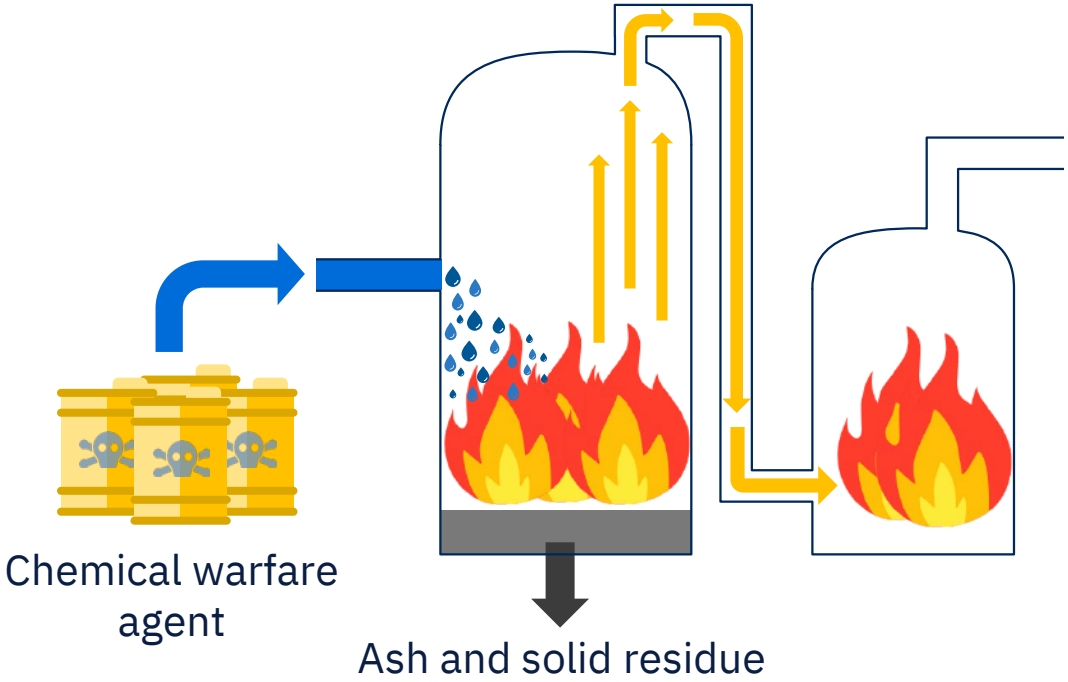
Disassembly – “drill and drain”
The chemical weapons/munitions are disassembled **to separate the chemical agents** from other components, such as explosives and metal casings

Incineration overview



Primary furnace
The chemical warfare agent is burned at temperatures exceeding 1000°C (~2000F)

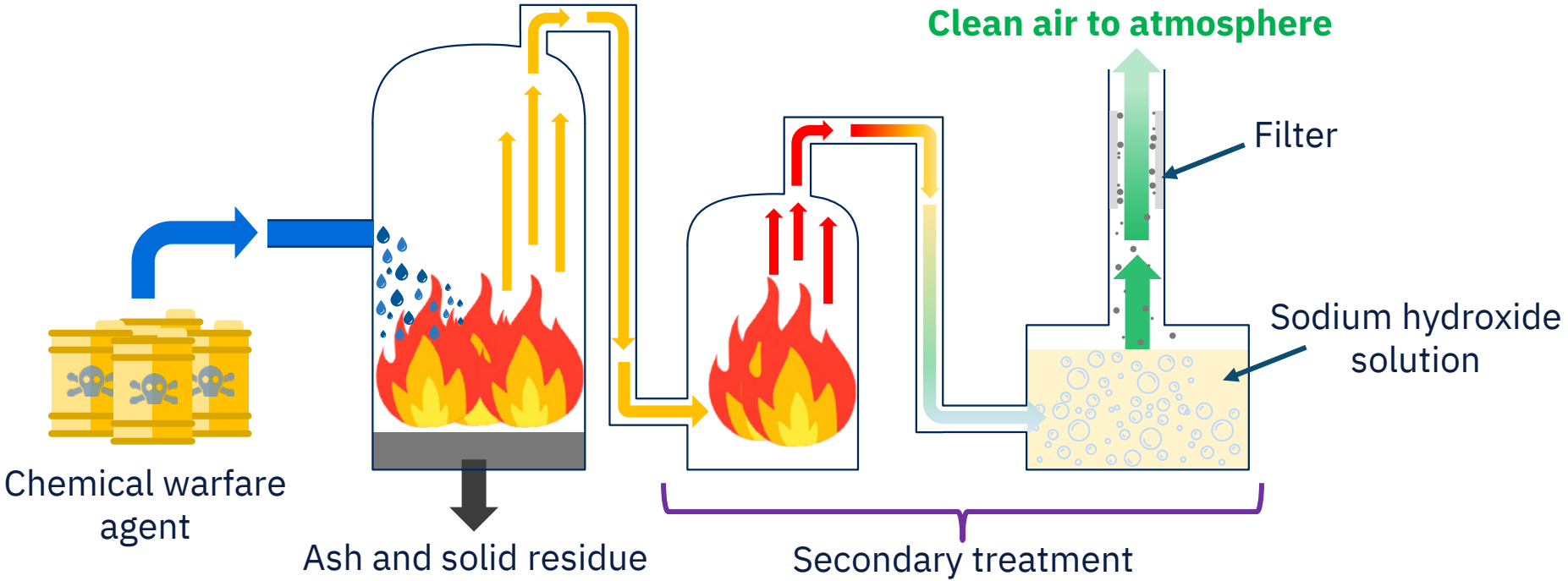
Incineration overview



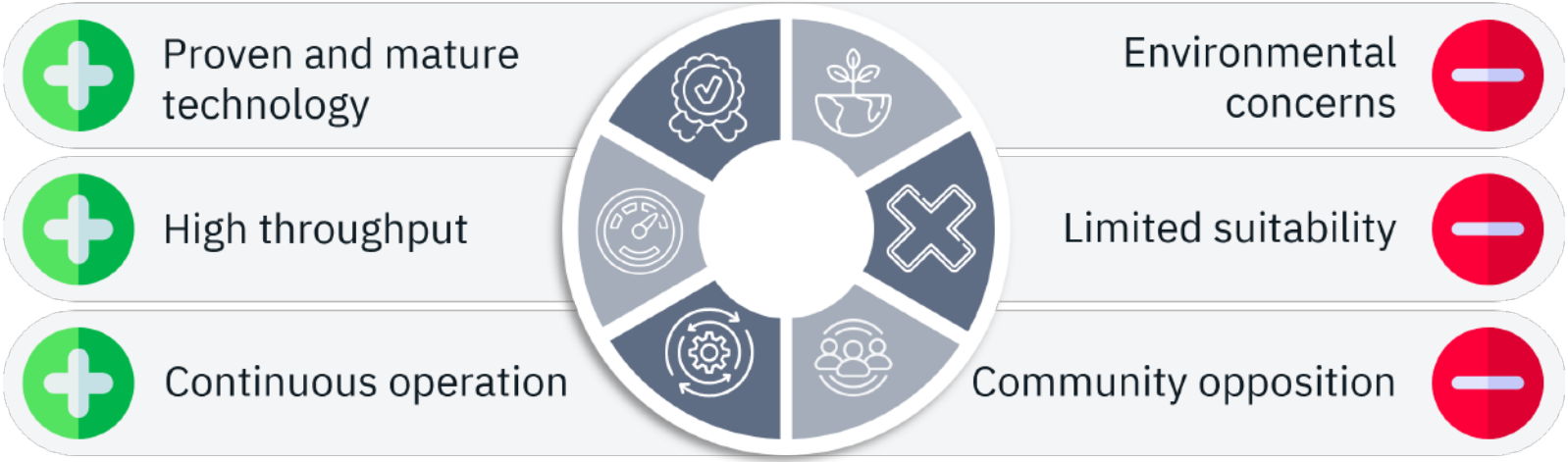
Secondary furnace
Ensures the complete destruction of any remaining hazardous substances

Incineration overview

Scrubber and filter
Caustic scrubber neutralises acidic gases and filter removes any fine ash or dust

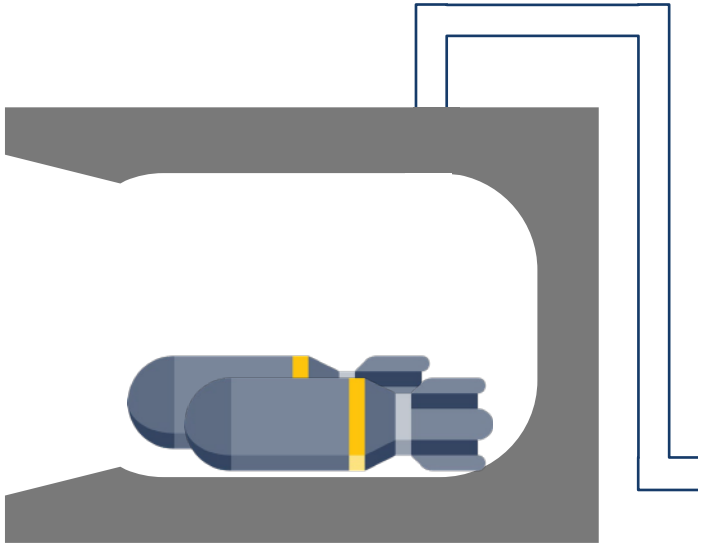


Benefits and challenges



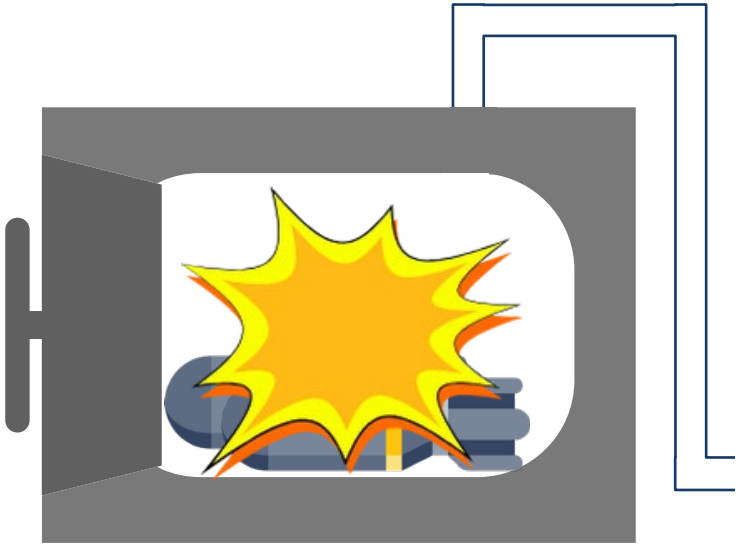

Detonation chambers

Detonation chambers



No disassembly required
Unlike incineration, there is **no need to separate the chemical agents** from other components

Detonation chambers

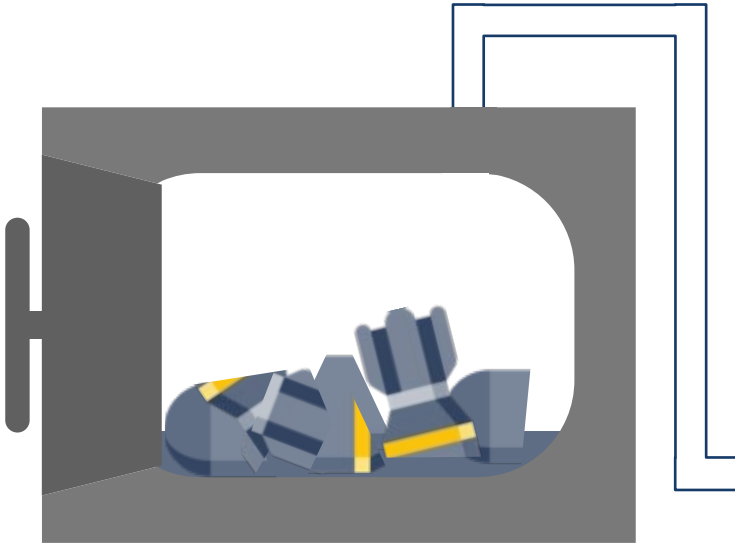


Sealed, armoured vessel
Munitions and contents are fully contained in a blast proof vessel.

Three types of detonation chamber:

- Explosive Destruction System
- Static Detonation Chamber
- Controlled Detonation Chamber

Detonation chambers



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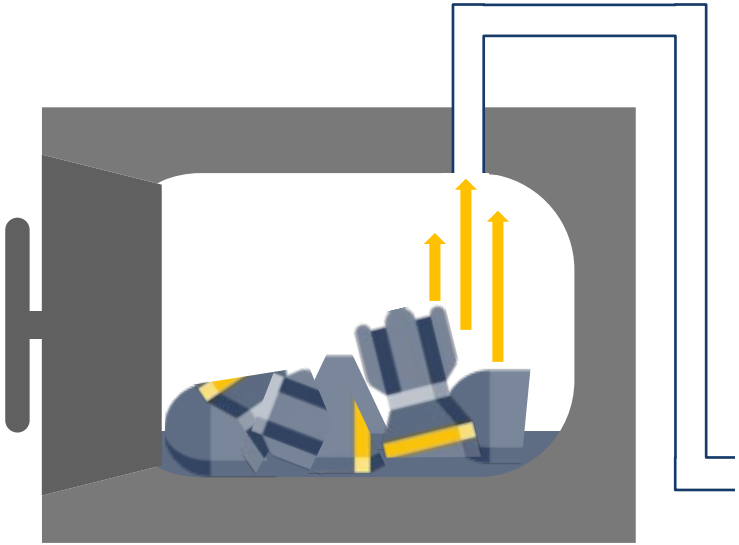

Off-gas treatment required
Ensures the complete destruction of any remaining hazardous substances

Detonation chambers

Off-gas treatment required
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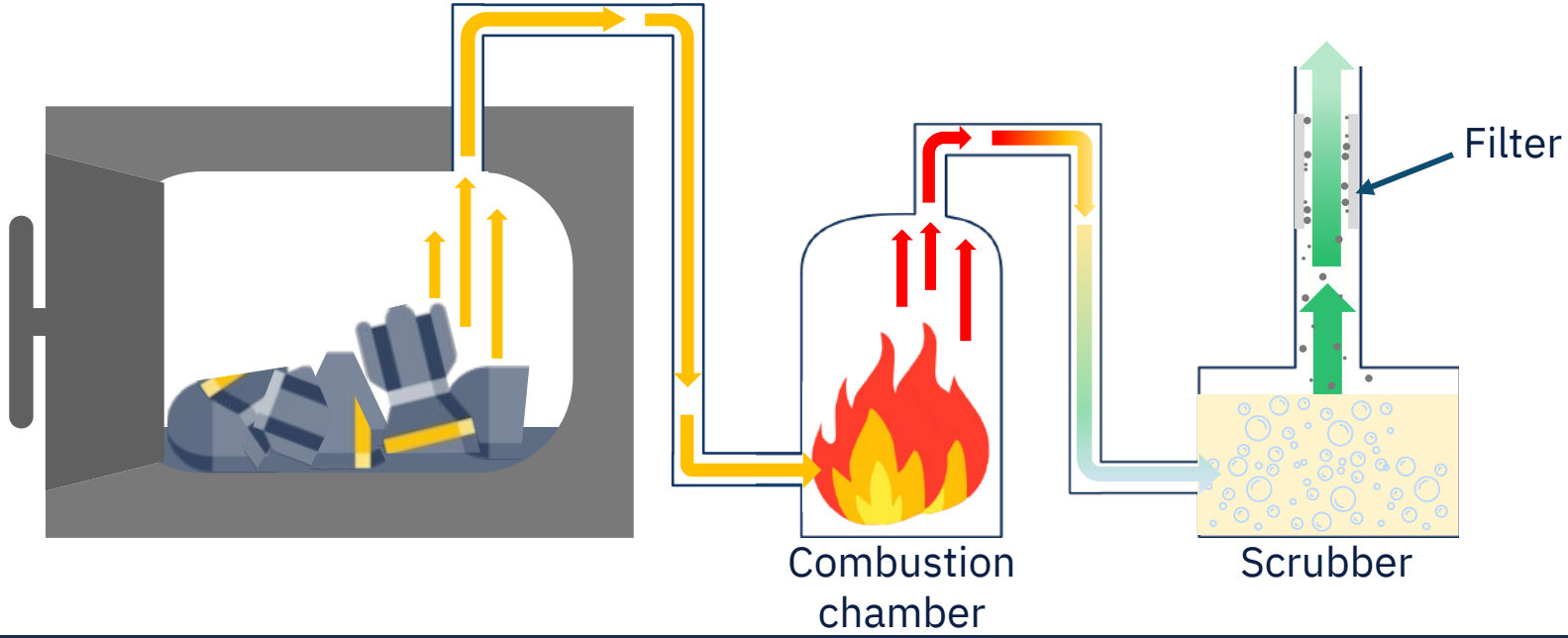
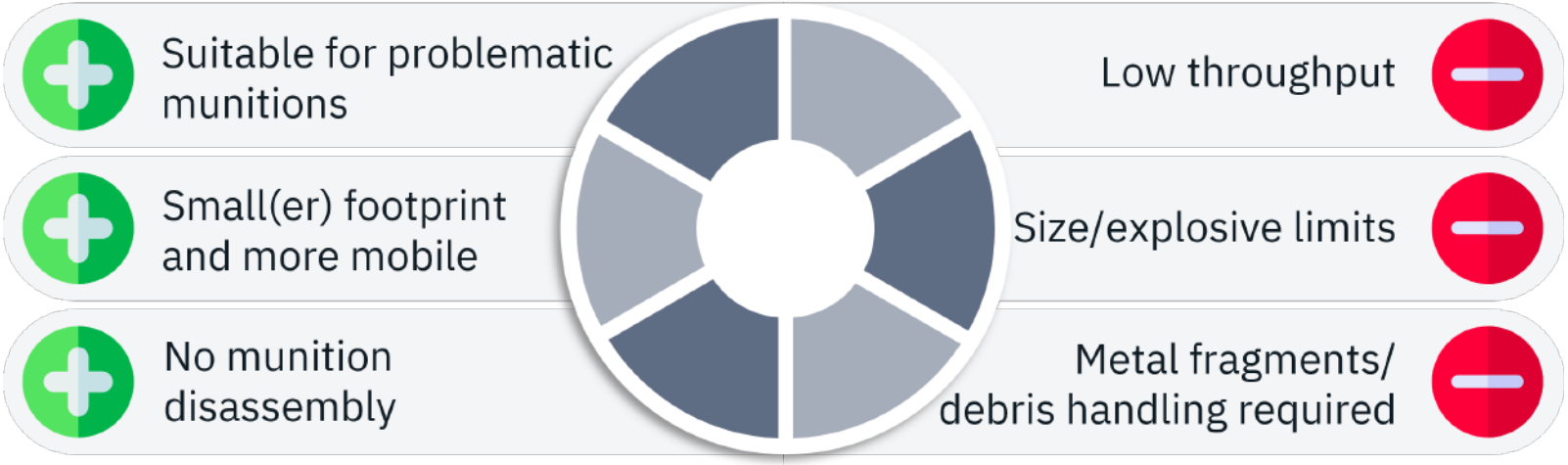
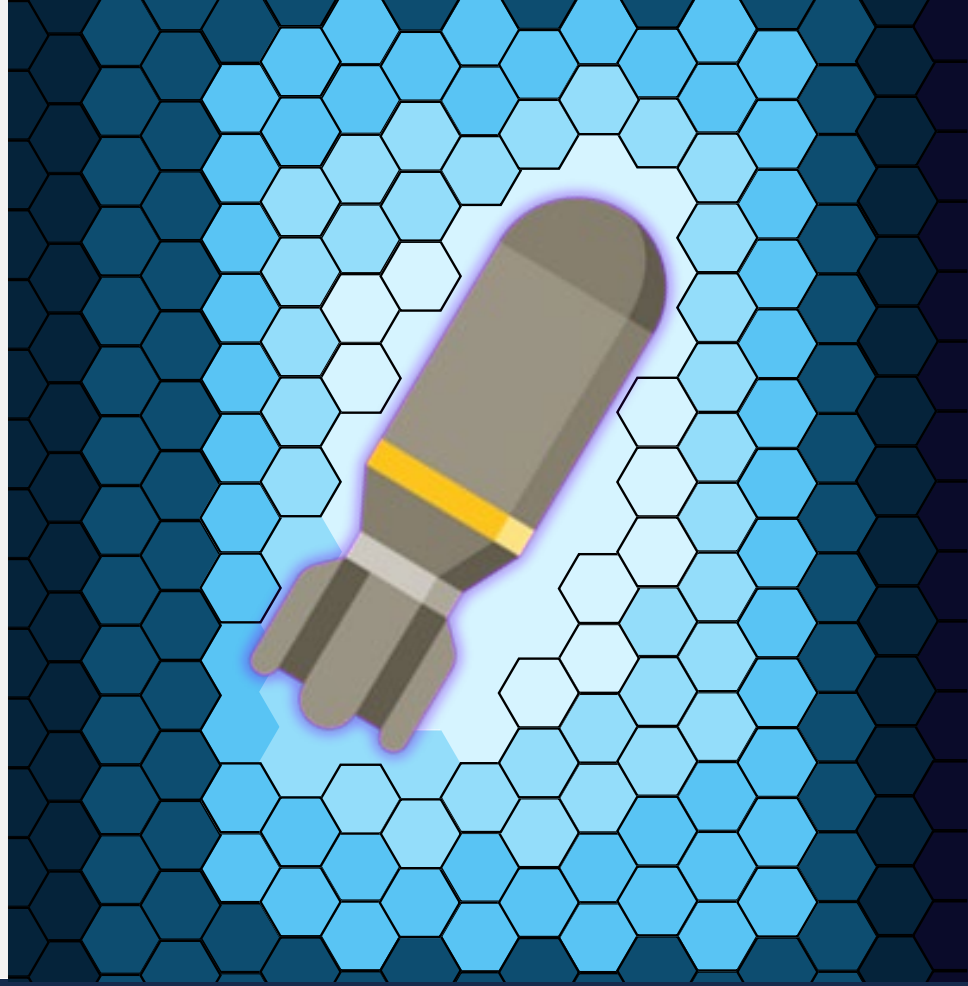


https://www.youtube.com/watch?v=k7QX3XJWsQs

Benefits and challenges



Low-temperature methods

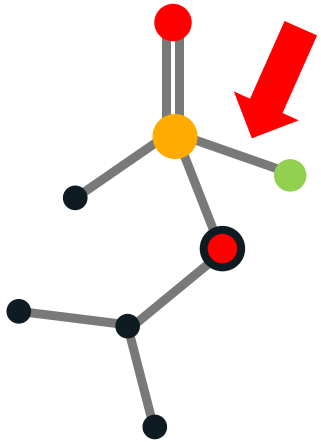


Neutralisation

Neutralisation

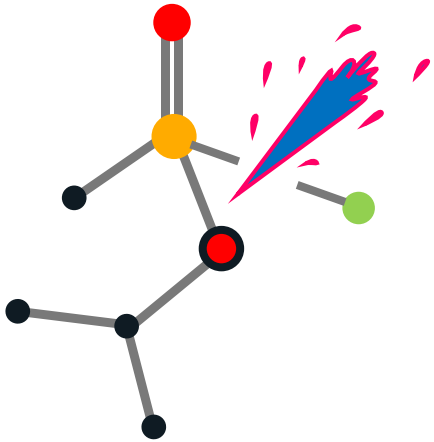
A **chemical reaction** **between a toxic chemical warfare agent and another substance**—usually water, sodium hydroxide, or sodium hypochlorite—to form less toxic products

Neutralisation

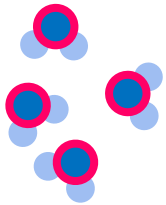


SARIN

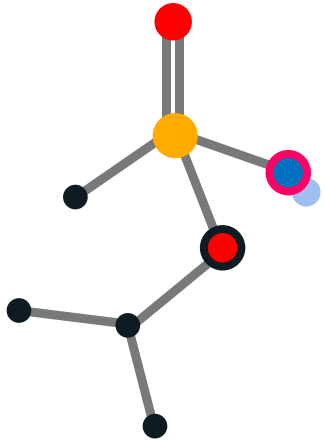
Neutralisation



SARIN



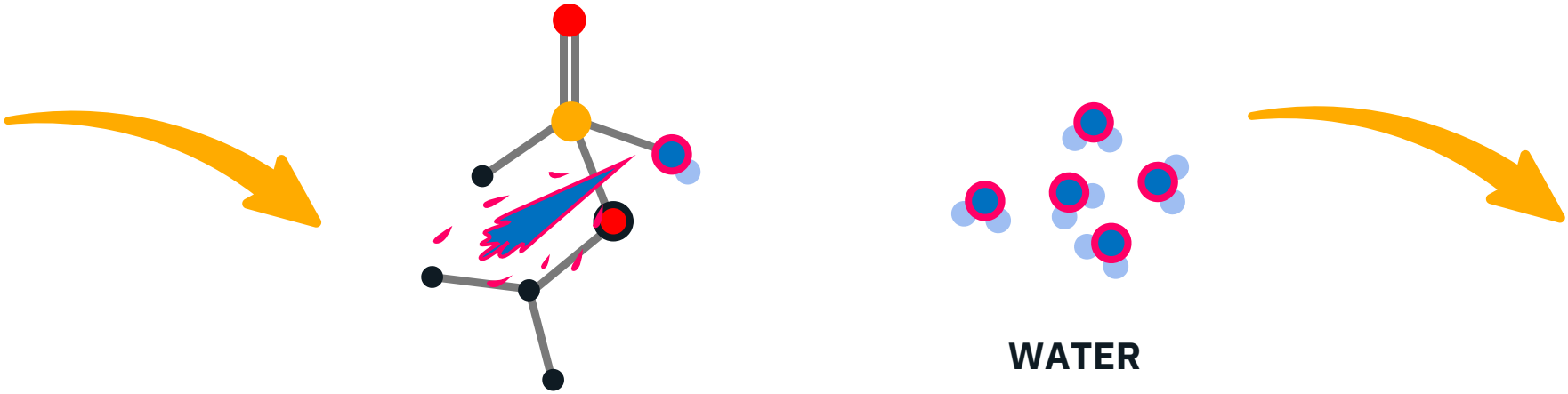
WATER



LESS TOXIC PRODUCT

Schedule 2 chemical

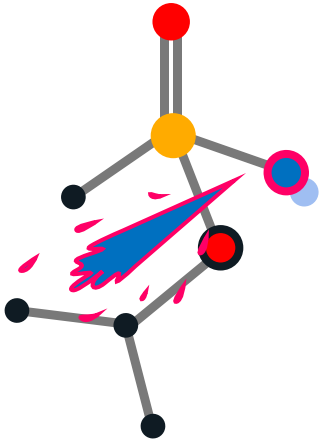
Neutralisation



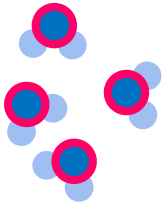
LESS TOXIC PRODUCT

WATER

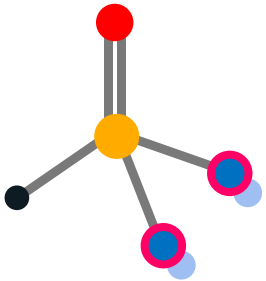
Neutralisation



LESS TOXIC PRODUCT



WATER



EVEN LESS TOXIC PRODUCT

Schedule 2 chemical

Benefits and challenges

Field deployable hydrolysis system

Transportable modular destruction system

Small footprint

Fast set up

Daily throughput: **5 to 25 MT**

Cape Ray destruction:
Sulfur mustard – 20 MT
DF – 540 MT
Substance A – 130 MT

Photo by Andrea Chaney, Defense Threat Reduction Agency

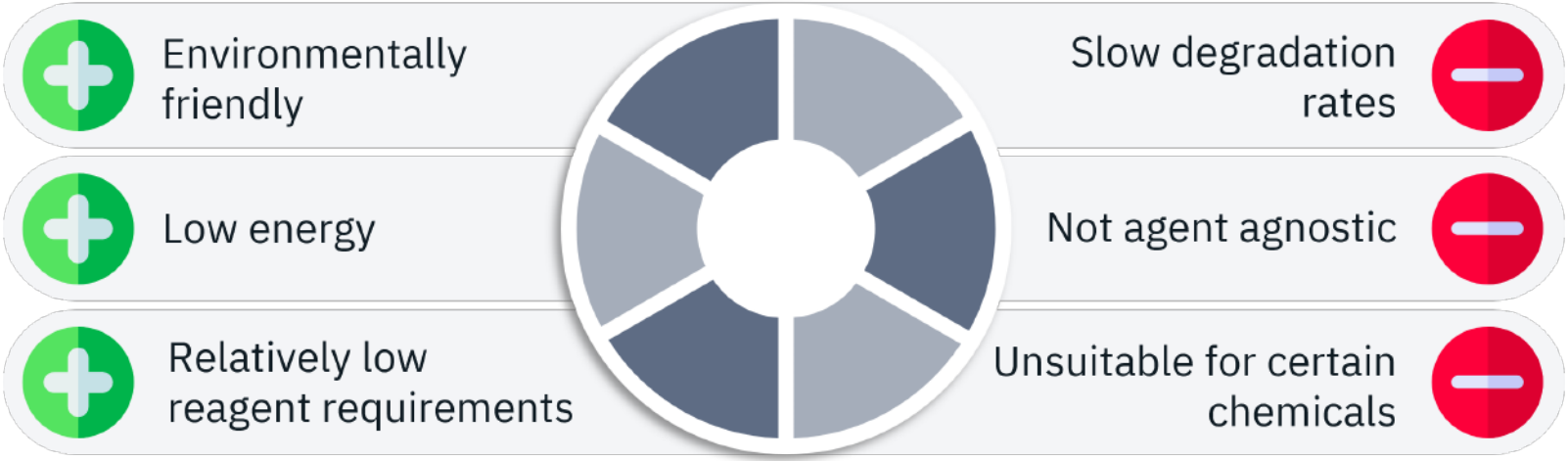
The appearance of U.S. Department of Defense (DoW) visual information does not imply or constitute DoW endorsement.


Biodegradation

Biodegradation

Using bacteria to digest hazardous chemicals

Benefits and challenges



Bituminisation

Bituminisation

Mixing the neutralisation reaction products with asphalt and other additives to form solid blocks

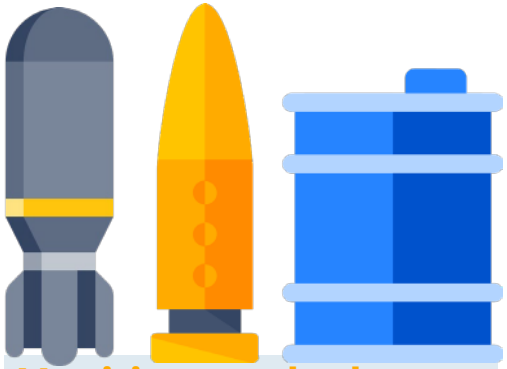
Benefits and challenges

Destruction of chemical weapons

1

Chemicals are converted in an **irreversible** way to a form **unsuitable for production of chemical weapons**

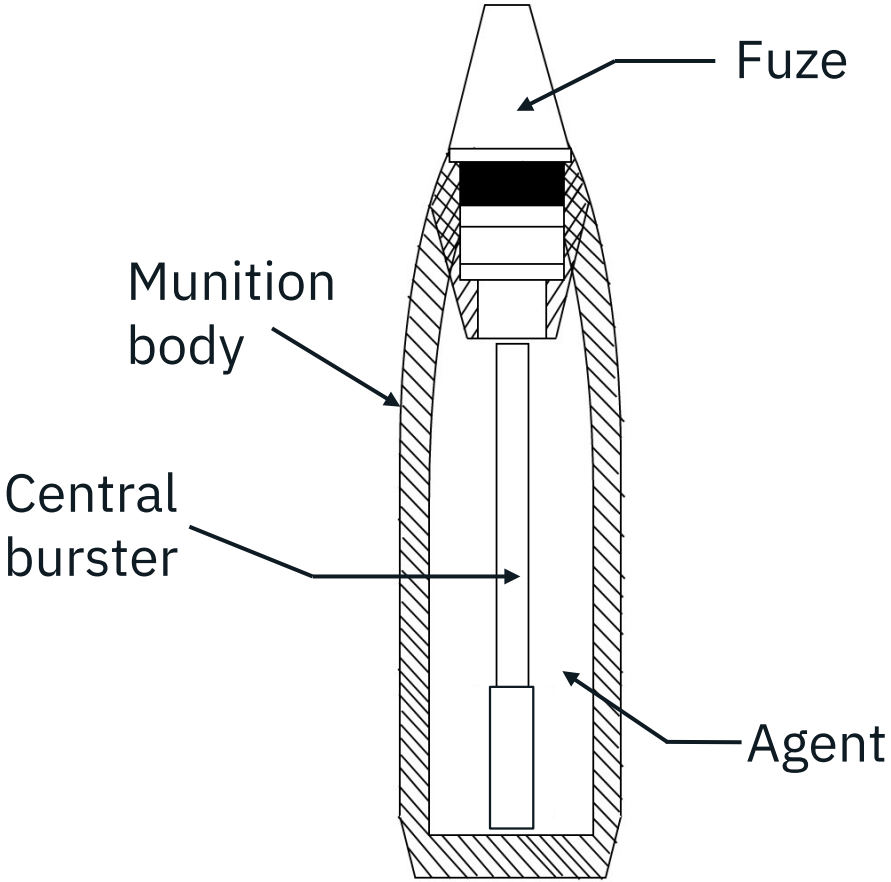
2



Munitions and other devices are processed in an **irreversible** manner, **rendering them unusable**

Guided activity

Perform **two-stage low-temperature destruction** of sarin in a 105mm projectile



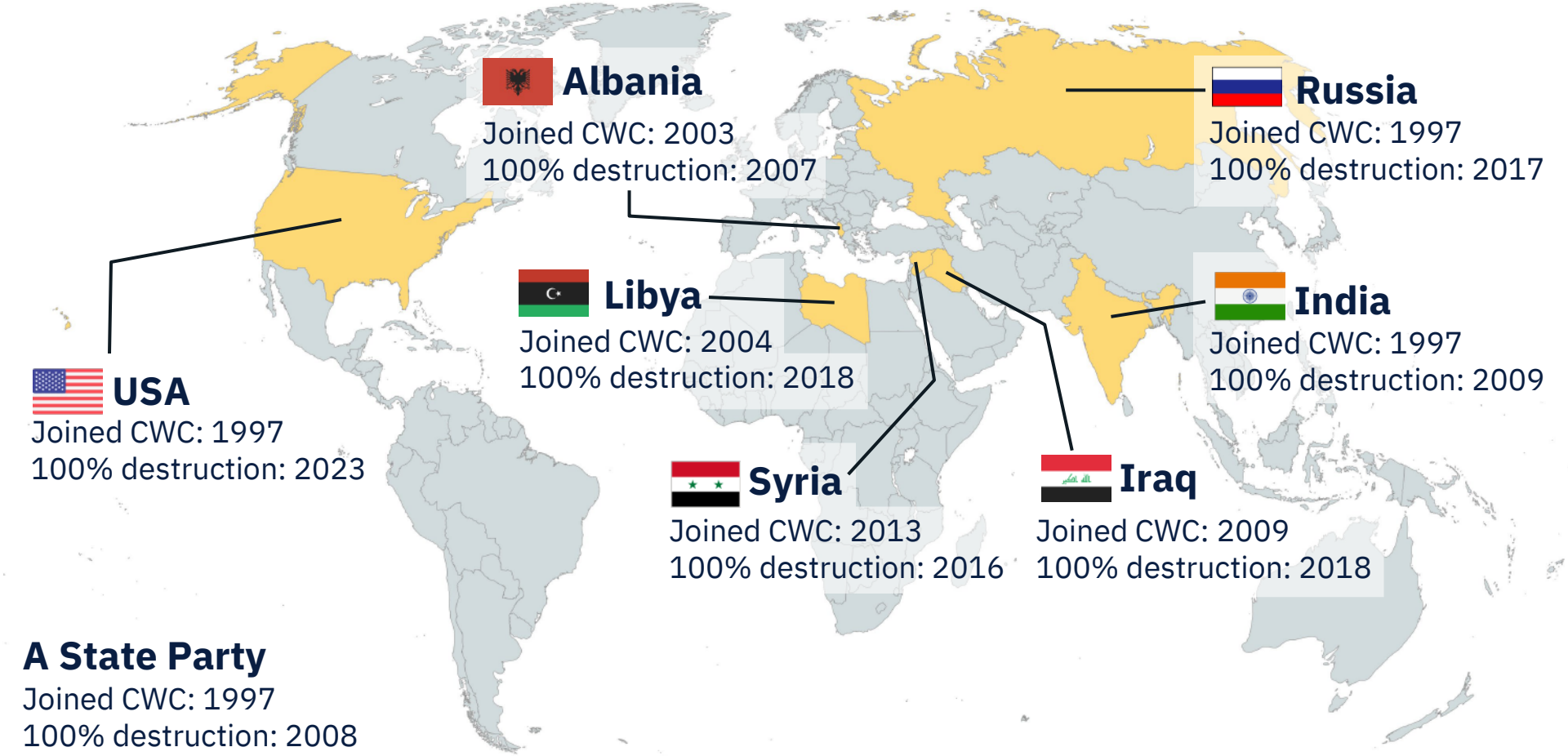
Verification

OPCW inspectors maintain a continuous on-site presence during destruction operations

- Confirm identity and quantity destroyed
- Monitor non-diversion in the destruction process
- *Review destruction records*
- *Review CCTV and photographic records*

Achievements

Destruction of declared stockpiles



Albania
Joined CWC: 2003
100% destruction: 2007

Russia
Joined CWC: 1997
100% destruction: 2017

Libya
Joined CWC: 2004
100% destruction: 2018

India
Joined CWC: 1997
100% destruction: 2009

USA
Joined CWC: 1997
100% destruction: 2023

Syria
Joined CWC: 2013
100% destruction: 2016

Iraq
Joined CWC: 2009
100% destruction: 2018

A State Party
Joined CWC: 1997
100% destruction: 2008

100%

OF STOCKPILE CHEMICAL WEAPONS DECLARED BY POSSESSOR STATES VERIFIABLY DESTROYED

72,304

metric tonnes of Category 1 and 2 chemical weapons

417,833

items of Category 3 chemical weapons

Our work is not over

- Syria
- Old chemical weapons
- Abandoned chemical weapons
- Non-State actors
- Chemical terrorism
- Four countries yet to join the Convention

Summary

- All chemical weapons must be destroyed using a **verifiable destruction method**. This method must be **irreversible** and destroy declared chemical weapons in a **safe and environmentally friendly** way.
- Destruction methods can be classed as either **high- or low-temperature methods**. High-temperature processes include incineration and detonation chambers, while low-temperature processes are based on neutralisation reactions. **Both methods require secondary treatment** for complete detoxification of the chemical warfare agents.
- Although 100% of declared stockpiles have been verifiably destroyed, the **destruction of old and abandoned chemical weapons continues**.