

Chlorine explosion in Jordan

NZASE Science Communicator Mike Stone explains the chemistry behind a recent major chlorine explosion.

On June 27, 2022, at the Port of Aqaba, Jordan, a container carrying chlorine fell and ruptured, releasing the **toxic** gas, killing 13 people and injuring more than 265.

Aqaba is on the northern tip of the Red Sea, near borders with Israel and Saudi Arabia. It is popular with tourists for its beach and diving, as well as its location near the city of Petra. Aqaba is Jordan's only port, a major transit point for imports and exports.

The accident

The container ship *Forest 6*, moored in dock 4, was loading a series of pressurised tanks of chlorine by crane when one of the cables snapped. The tank fell to the deck and ruptured, explosively releasing a yellow-green cloud of poisonous chlorine gas. People ran and trucks sped away from the spreading gas cloud on dock 4, as [captured by CCTV footage](#).

The response

Authorities arrived quickly, evacuated the port, and quarantined the area inside a 500 m cordon. Forty-five first responders were among the casualties, who were taken to four local hospitals, with some flown north to Amman.

The beach 7 km to the south was closed and residents of Aqaba city, 16 km north, were advised to stay inside and close windows and doors. Roads into the city were closed.



At the time of disaster a wind was blowing from the north at moderate speed away from the city, past the port to the outlying desert, which prevented more casualties.

A team of hazardous materials specialists from Jordan's Civil Defence cleaned the site. The port was shut down for one day, stopping all ship movement, with dock 4 closed for a further day for safety checks.

The port's grain **silos**, 600 m from dock 4, are built of concrete and hermetically sealed. Despite that, as a precaution the grain was checked for chlorine gas contamination. Fortunately there were no grain carriers loading or unloading at the time.

A government investigation identified several safety hazards. The 25 tonne tank was three times the weight of the cables' carrying capacity. The required safety measures for dealing with such hazardous material were not in place. And no safety attendant was on the deck to check loading and unloading procedures. Three senior officials of this commercial port were deemed responsible and fired.

However, Jordanian analysts say senior positions in Jordanian businesses are often appointed by the government, regardless of qualifications or experience.

Industry sources had long warned safety measures were insufficient at this site. The incident could have been more of a catastrophe had dozens of workers not left the site after the end of their shift, shortly before the leak. Six days after the explosion, the union announced a work stoppage to protest poor safety conditions.

CCTV footage on the Jordanian state TV channel Al-Mamlaka showed the cylinder plunging from a crane, causing an explosion of yellow gas in Aqaba port.



Chlorine chemistry

Chlorine gas is a toxic, **corrosive**, and greenish yellow halogen. With a **boiling point** of -34°C , it is a gas at room temperature and atmospheric pressure. It is usually pressurised and cooled for storage and shipment. The gas is heavier than air, so gas clouds tend to concentrate in one area and will be affected by wind movement. Chlorine has a range of uses:

- As a **disinfectant** for drinking water and swimming pools and, as bleach, for kitchen and bathroom surfaces.
- In the manufacture of medicines, solar panels, computer processors, refrigerants, electric car batteries and plastic foam insulation.
- To make **organic substances** like PVC, as chlorine is an oxidising agent and a substitution reactant.
- As a chemical weapon in World War I. Inhalation or skin contact with chlorine causes harm quickly. Chlorine is soluble; in water it forms hypochlorous and hydrochloric acid, which produce oxygen free radicals that damage cells in people's airways. Patients experience suffocation, constriction of the chest, tightness in the throat, and after severe exposure their lungs fill with fluid. As little as one part per thousand in air causes death in a few minutes.

Questions

1. Define the six terms in **bold italics**.
2. In what state was the chlorine in the tank?
3. If chlorine did not react with oxygen, what was the explosion?
4. Why would chlorine be pressurised and cooled for storage and shipment?
5. What would have been the complication if grain was being loaded at the time of the explosion?
 6. **A.** What are the differences between hypochlorous and hydrochloric acid (include formulae)?
B. Work out the equation for chlorine reacting with water.
7. What are oxygen free radicals?
8. **A.** Find out about the use of chlorine gas as a chemical weapon in WWI. What is chlorine's density and why was this important? How did



The ruptured chlorine tank. AFP.

soldiers protect themselves before gas masks were developed?

B. Chlorine is now banned as a chemical weapon. Why might that be? Debate the issue: "Should we make it just because we can?"

9. What is the link between chlorine and bleach? Look at the label on a bleach container – what does it tell you?

10. What would be the safety symbols associated with chlorine? ([Use this master list](#); see if you can work it out before looking it up.)

11. Toxic substances like chlorine can affect the mauri of the taiao.

A. What are the implications for us as kai-tiaki; for example, at home dealing with toxic substances such as bleach, petrol, oil, paint, weed or insect sprays?

B. What does it mean for us in the science classroom?

Sources

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Ngā Kupu

Haumāota – Chlorine
Pae koropupū – Boiling point
Pakūtanga – Explosion
Pēhanga kōhauhau – Atmospheric pressure
Pūnguru – Corrode; corrosion
Tāoke – Toxic
Taiao – Environment.

From Te Aka Maori Dictionary
and Paekupu

