

## DANGERS OF CHLORINE EXPOSURE

In June 2022, [12 persons were killed and hundreds injured](#) at a Jordanian port after a storage tank containing liquified chlorine plunged onto the deck of a ship and released a large volume of chlorine gas. Could this happen in Singapore, and how can we prevent such an accident?



Footage showing a large cloud of chlorine gas at Jordan's Aqaba port.  
(Photo: AFP/Al Mamlaka TV)

Chlorine is used as an oxidising or chlorinating agent in the manufacture of chemicals and plastics. It is commonly used in bleaching or as a disinfectant for industrial water treatment and pool sanitation in Singapore. Gaseous chlorine is pungent and can cause severe breathing difficulties, due to the formation of corrosive acids when chlorine gas meets moisture in the respiratory tract. While not flammable, it is a strong oxidising agent and is able to react explosively or form explosive compounds with other chemicals. Chlorine can be used and transported safely unless there is a container rupture (as in the Jordan case) or if there are container faults, as has happened in Singapore before – see case 1 below.

This bulletin is meant to share the lessons from past chlorine leaks and chlorine-related accidents that occurred in Singapore so as to prevent recurrence.

## Case 1: Leak at chlorine cylinder storage facility

In 2016, a liquid chlorine leak ensued from a corroded fusible plug connection of a 1-ton container in a chlorine storage facility. When the leak detector alarm sounded, an operator activated the chlorine gas emergency scrubber and exhaust system. However, as the emergency scrubber and exhaust system were not installed according to design, it failed to achieve sufficient air change rate to purge out the leaked chlorine gas. Two workers attempted to stop the liquid leak but were unsuccessful. The leak was eventually stopped with assistance from the Singapore Civil Defence Force (SCDF).

Two SCDF responders and five members of the public were injured due to momentarily being exposed to the leaked chlorine gas. Their injuries ranged from eye irritation to breathing difficulties.



Photo of the corroded fusible plug connection

More details on this case can be found [here](#).

## Recommendations

To prevent similar accidents, consider implementing the following measures:

- **Safe transportation:** Loading, unloading and transfer of containers storing hazardous chemicals are high risk operations. Proper planning and safe work procedures have to be established to ensure safe operation. Transportation of Dangerous Goods within or outside a company must comply with SS586 Part 1: Transport and storage of dangerous goods.
- **Regular equipment inspection:** Inspect fusible plugs of the containers before each filling for early detection of any corrosion damage and trigger replacement of fusible plugs if required.
- **Safe storage:** Provide sufficient separation between containers for emergency response. In this case, the leaking chlorine container was stored too closely to other containers, and workers were not able to rotate the container to slow down the leak. Rotating the container to maximise the height of the fusible plug to the ground would change the liquid leak into a gas leak, reducing the amount released.
- **Effective scrubber and exhaust system:** Ensure that the emergency scrubber and exhaust system is adequately designed to maintain a safe air change rate in the workplace. Regular maintenance ensures that the emergency scrubber and exhaust system functions

effectively upon activation to extract contaminated air to the scrubber. Never turn off safety interlocks that will activate the scrubber and exhaust system in an emergency.

- **Emergency Response Plan (ERP):** Plan for both gas leak and liquid leak scenarios. The ERP should cover evacuation procedures, how the source of release can be sealed, and how the affected area can be contained and properly decontaminated.
- **Trained personnel and personal protective equipment:** The Company Emergency Response Team (CERT) must be trained to handle chlorine incidents and be equipped with full body HAZMAT suits and the necessary respiratory protection. For major chlorine leaks or spills, notify SCDF immediately.

Other than chlorine, chlorine containing compounds such as calcium hypochlorite and trichloroisocyanuric acid are also commonly used in residential settings, for disinfecting swimming pool water. Chlorine-containing compounds can cause explosion and chemical burns if chemical reactions with other substances occur in an uncontrolled way.

### Case 2: Explosion at swimming pool

A worker was tasked to dose 7kg of calcium hypochlorite into a condominium's swimming pool as part of scheduled pool maintenance works. While dosing the calcium hypochlorite powder into the pool's overflow drainpipe, a residual amount of water in the drainpipe reacted vigorously with the powder, resulting in an explosion. This caused the worker to fall, injuring his forehead and fracturing his leg.



Photo of the drain where dosing was carried out.



Illustration of worker's position after falling forward.

### Case 3: Worker burnt by chemical mixture

A cleaning supervisor used chlorine to remove algae in the air well of a condominium. As he added a chlorine-containing chemical (granular trichloroisocyanuric acid 90%) to a pail of water, the acid and water reacted vigorously and produced steam, chlorine gas and nitrogen trichloride, a highly explosive compound. The chemicals splashed onto his body, and he was hospitalised for five days due to chemical burns.



Granular trichloroisocyanuric acid (for swimming pool)



Interior of the pump room with containers of granular acid.

### Recommendations

To prevent similar accidents, consider implementing the following measures:

- **Risk assessment:** Conduct a risk assessment for work activities carried out at the swimming pool premises, including the hazards of chemicals and precautionary measures to be taken when handling chemicals.
- **Safe Work Procedures (SWPs):** Establish and document SWPs to facilitate swimming pool operations in a safe manner. These procedures should include measures to safeguard the health and safety of persons handling chemicals such as during dispensing of chemicals, preparation of dosing chemicals and treatment of unused chemicals for disposal if required, and emergency response for chemical spillage and leaks.
- **Labelling of chemicals:** Identify chemicals clearly by labelling all containers, the hazards involved and precautions to be taken, in accordance with SS 586 Part 2: Globally harmonised system of classification and labelling of chemicals – Singapore's adaptations.
- **Training and awareness:** Allow only trained workers to handle chemicals. They must be trained on the hazards involved and the precautions to be taken when handling chemicals. Provide copies of the Safety Data Sheets and make them readily accessible to persons at work areas where the chemicals are used or handled.
- **Storage of chemicals:** Store hazardous chemicals properly under lock and key. Place its control under a competent person who has adequate knowledge of the properties of the hazardous chemicals and their dangers. Give only authorised persons access to the chemical storage.

Please refer to the joint circular on [Guidelines on the Use of Chlorine-Containing Chemicals for Disinfection of Swimming Pools](#) for more details.

For more information on chemical management, please refer to SS 586 Specification for hazard communication for hazardous chemicals and dangerous goods, and the WSH Council's [WSH Guidelines on Management of Hazardous Chemicals Programme](#).