

FEEDERLINES

Lessons identified from the incident ground

Dilution versus Neutralisation in HazSubs Incidents

Introduction

When firefighters respond to incidents involving hazardous substances (HazSubs), understanding the tactical options is crucial for ensuring safe outcomes. If it is an acid spill, two primary strategies are dilution and neutralisation. This operational lesson will explore these tactics, some of the terminology, our training, and procedures.

The Event

Fire crews were responded to a large commercial Plant where there was a spill of 1000 litres of 98% Sulphuric Acid (H_2SO_4) (UN1830). This was from an Intermediate Bulk Container (IBC) into a bunded area at the Plant.

A contractor that was delivering the IBC had accidentally discharged the chemical.

First arriving Fire and Emergency crews were instructed by their Officer (OIC Fire) to apply approximately 10,000 litres of water to the spill. This was done to corral the acid and dilute the substance within the bunded area.

This action overwhelmed the Plant's containment system. It allowed concentrated amounts of acid to cascade beyond the bunding and onto a nearby driveway and dry culvert that ran alongside a roadside berm.

OIC Fire believed that once the acid was pushed towards the dirt, "it would do its natural thing". This was based on OIC Fire's experience from previous, similar incidents they had attended.

Fire and Emergency's initial response to this Sulphuric Acid spill was not managed as well as it could have been, due in part to assumptions about dilution of the acid versus neutralisation. However, subsequent actions undertaken by fire crews improved, with better adherence to safety protocols, effective neutralisation of chemical hazards, and the establishment of a proper incident management structure which led to an effective resolution of the incident.

An Operational Assurance Review and Level 2 ICAM Investigation were conducted for this incident, these recommended writing a FeederLines to explain Dilution versus Neutralisation as tactical options.



Fig 1 – 1000 litre IBC of 98% Sulphuric Acid

Dilution versus Neutralisation

Understanding the options

When dealing with chemical substances of any kind, seek advice from Queensland Fire Dept (QFD) Specialist Science Advice Team through Fire and Emergency ComCen before deciding on tactical options.

We have 24/7 access to this team of experts who can tell you what to do and what not to do, when to proceed and when to hold back and wait for support.

The nature and concentration of chemicals is widely varied, and our response needs to be appropriate for the situation we face.

Example: 4% Acetic Acid is household vinegar - 37% Acetic Acid causes immediate lung, eye, and skin irritations and is flammable.

Sulphuric Acid is a highly corrosive and reactive substance, it poses significant risks, including severe chemical burns and reactions with other materials. A spill of 1000 litres of 98 % Sulphuric Acid (as happened in this event) would take approximately 3.2 tonnes of Sodium Bicarbonate to neutralise - or 1,000,000,000,000 litres of water to dilute to pH 7 (neutral) - which is roughly equivalent to all of Wellington Harbour.

Neither would be a good option, so something else would be advised. This is where (QFD) Specialist Science Advice is vital. Changing the neutralisation agent would reduce the amount required to a useful amount. It would still be a lot more than carried on any fire appliance though.

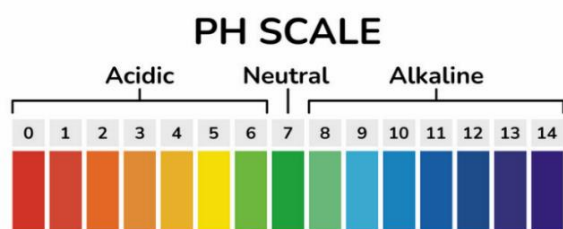


Fig 2 – Litmus paper colour chart

Our process and procedures

HazSubs incidents are often complex in nature and require a significant amount of time to resolve. Factors such as the quantity and type of hazardous substances, the weather conditions on the day of the incident, the risks posed to the safety of fire crews, the environment, and the public must all be accounted for when planning strategy and tactics.

One of Fire and Emergency's legislated roles is to respond to hazardous substance emergencies. Two of our main functions under [section 11\(2\)\(external link\)](#) of the Fire and Emergency New Zealand Act 2017 (the Act) are:

11.2.(c) "to stabilise or render safe incidents that involve hazardous substances; and 11.2.(d) to provide for the safety of persons and property endangered by incidents involving hazardous substances"

A HazSubs emergency only ends once it is rendered safe. [Section 7\(external link\)](#) of the Act sets our options for rendering safe, including containing the substance, treating it to make it non-hazardous, stabilising, neutralising or absorbing it, removing or handing it over to another person/authority. One or more options may be appropriate for any particular incident.

Fire and Emergency guideline H1b-gd [Rendering safe hazardous substances at emergencies](#) explains what it means to stabilise or render safe hazardous substances at an emergency. For incidents involving HazSubs consider these initial actions. (Refer Sec 13 in your [Incident-Response-Guide-MOBILITY.pdf](#))

- Only the first arriving appliance should approach and investigate - from upwind/uphill/upstream if possible.
- Advise other responding appliances and partner agencies through ComCen of the safe approach route and safe forward point clear of the incident.
- Consider upgrading to a greater alarm.
- Conduct a size-up, Dynamic Risk Assessment and operate under the Safe Person Concept.
- Follow the **RICIMD** process for HazSubs – **R**isk to life, **I**solate, **C**ontain, **I**dentify, **M**ake safe, **D**econtaminate.
- All personnel **must** wear PPE appropriate to the hazards.
- Appoint a Safety Officer when a Hot Zone is identified and consider a Hazard Control Officer if working inside the Hot Zone. (refer [IS1-Operational-safety-NCI.pdf](#))

Neutralisation - involves applying another chemical to the HazSub to neutralise its harmful properties. For example, acids can be neutralised by adding a base (alkaline substance) and vice versa. Neutralisation helps to make the HazSub less harmful or harmless, making it safe to handle, dispose of, or discharge. You must select the appropriate neutralising agent and control the reaction to prevent any dangerous byproducts or heat build-up.

Dilution - involves reducing the concentration of a HazSub by mixing it with a large volume of water or other suitable non-hazardous liquid to lower its harmful effects to safer levels. It is often used to make a substance less hazardous and easier to manage or clean up. It is important to ensure that the dilution process is appropriate and does not create additional hazards or environmental concerns.



Resource Hub

FENZ Incident Response Guide – HazSubs [Incident-Response-Guide-MOBILITY.pdf](#)

FENZ Rendering Safe Guide [Rendering safe hazardous substances at emergencies](#)

FENZ Ops Safety NCI [IS1-Operational-safety-NCI.pdf](#)

Emergency Response Guide (ERG Book) [ANZERG2024 - Emergency Response Guides](#)



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