

The Curious Case of Acryloyl Chloride

Is it a case of misinformation or misinterpretation of Safety Data Sheets?

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ABSTRACT

The primary function of the Safety Data Sheet (SDS) is to provide essential information to workers, safety professionals, emergency responders, employers, and users regarding the health effects of a chemical, as well as the necessary precautions for its safe use, handling, storage, and transportation. As a critical hazard communication tool, it must be articulated clearly, avoiding any vague or misleading language.

Acryloyl Chloride is a highly reactive and unstable chemical that requires the presence of a stabiliser. Acryloyl Chloride reacts with water, producing hydrogen chloride gas. Yet, an SDS published in 2020 recommended that when using Acryloyl Chloride, an approved respirator should be used *“if exposure limits are exceeded or if irritation or other symptoms are experienced.”*^[1]

This statement raised considerable questions about the accuracy of the safety advice being provided. This incident prompted the review of SDS for Acryloyl chloride.

This case study forms part of a PhD Investigation into the accuracy of safety data sheets and the impact of inaccurate safety data sheets on risk assessments.



INTRODUCTION

In 2022, a student experienced severe medical symptoms after exposure to the highly toxic and reactive acryloyl chloride^[1]

The published case study suggested that the SDS was inaccurate, as it failed to document the various symptoms experienced by the student and failed to identify that it was known to cause pulmonary oedema post-exposure.^[1]

Section 8, "Exposure Control and Personal Protection," of the SDS clearly states in relation to respiratory protection that the user must *“Use a NIOSH/MSHA or EU Standard EN 149 approved respirator, if exposure limits are exceeded or if irritation or other symptoms are experienced.”*^[1]

The problem with the recommendation is that there is no safe exposure limit for Acryloyl Chloride, and putting on PPE after a worker has been exposed to Acryloyl Chloride and is suffering symptoms is too late.

The incident reported in 2022 is not the first incident to have been reported involving Acryloyl Chloride.

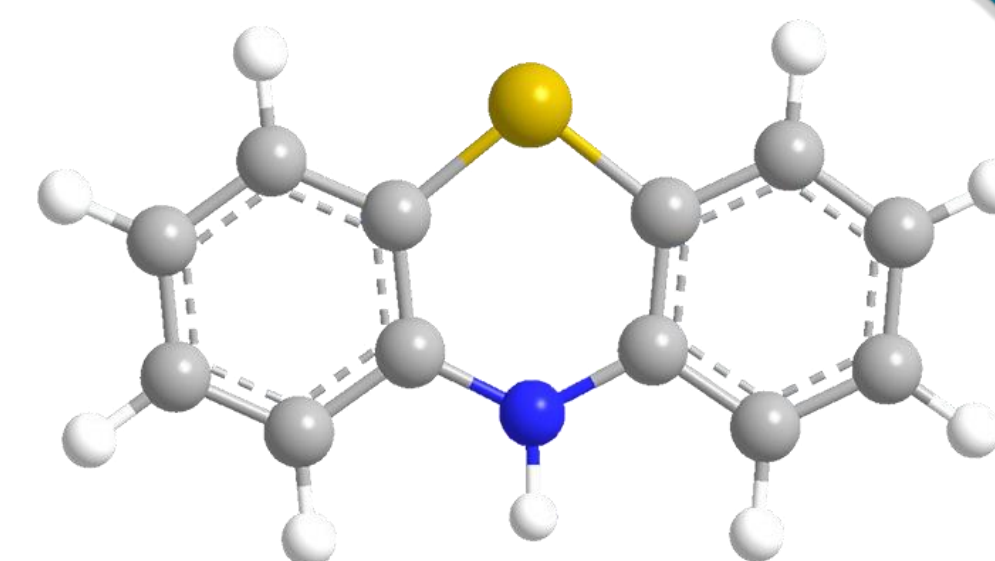
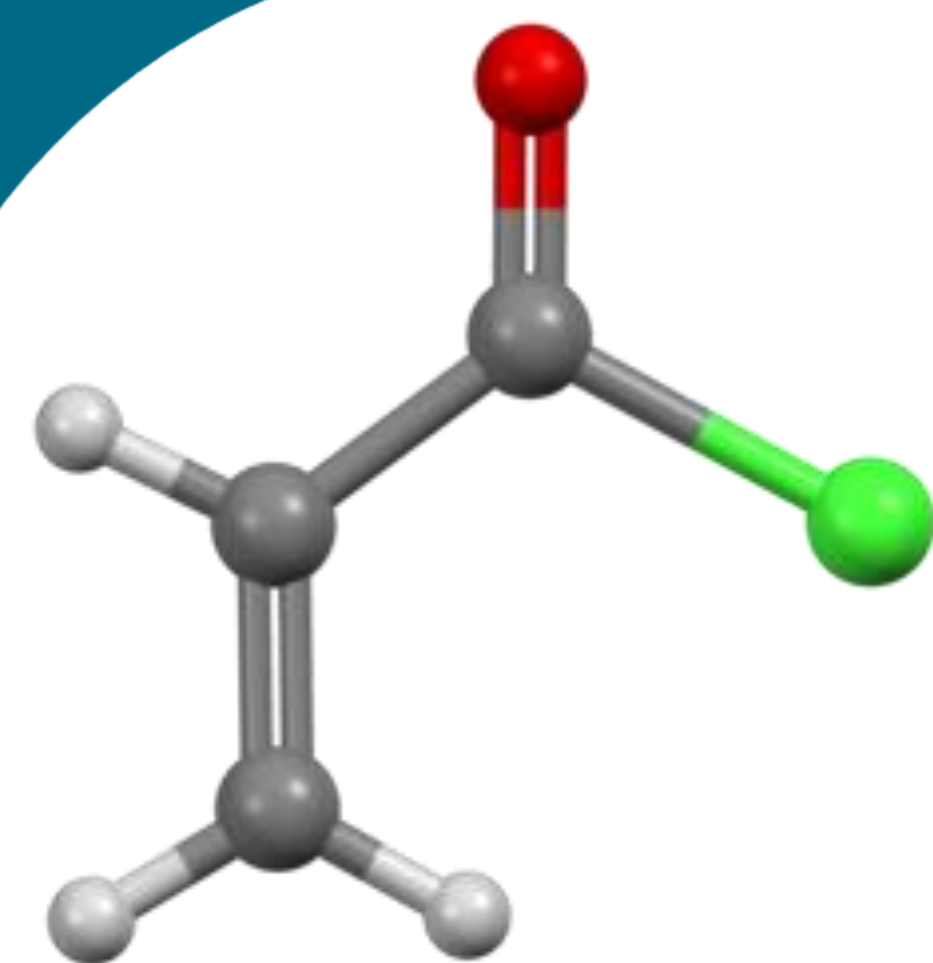
PRODUCT IDENTIFICATION

Acryloyl Chloride CAS No. 81-68-6

ALTERNATIVE NAMES :

Prop-2-enoyl chloride (**IUPAC Name**)
2-propenoyl chloride
acrylic acid chloride

Chemical formula C₃H₃ClO
Molar mass 90.51 g·mol⁻¹
Density 1.119 g/cm³
Boiling point 75.0 °C (167.0 °F; 348.1 K)
Flash Point -4 °C (25 °F; 269 K)
Stabiliser Phenothiazine 0.05%
Exposure Limit No data available



REPORTED INCIDENTS

1985 A 500-ml bottle of the acid chloride stabilised with 0.05% of phenothiazine polymerised, breaking the bottle and forming a solid foam after being shipped to a hot location without refrigeration and stored at 50°C. ^[2]

1998 A 25-year-old student died of pulmonary oedema after exposure to acryloyl chloride (96%) and methacrylic anhydride (94%). A 31-year-old male and a 25-year-old female developed pulmonary oedema after exposure to acryloyl chloride in the same incident.^[3]

2021 A 36-year-old male was diagnosed with acute respiratory distress syndrome post-exposure^[4]

2022 A postgraduate researcher suffered blackouts, headaches, dizziness, tiredness, nose bleeds, persistent burning of the eyes, and intense nausea and vomiting after exposure to acryloyl chloride.^[1]

OBJECTIVE

The research aimed to determine whether the statement included in the SDS for acryloyl chloride was an error or misinterpretation.

METHODOLOGY

13 SDS for acryloyl chloride with phenothiazine stabiliser were sourced and then underwent a line-by-line comparison. The SDS were then assessed against the requirements of the GHS 7th Edition (2017).

REFERENCES

- [1] Pathan, A., Ahmad, I., Girase, R., Jagatap, V., & Patel, H. (2022). *ACS Chemical Health & Safety*, 29(5)
- [2] Bretherick, L. (2017). *Bretherick's handbook of reactive chemical hazards* (P. G. Urben, Ed.; Eighth edition). Elsevier.
- [3] Lau, F. L., Chu, S. Y., & Yu, T. S. (1998). *European Journal of Emergency Medicine*, 5(2)
- [4] Shima, T., Kashiwagi, H., Ino, H., Tanaka, S., Fukuda, M and Kobata, H. *Acute Medicine & Surgery*, 2022;9
- [5] Globally Harmonised System of Classification and Labelling of Hazardous Chemicals Revision 7 (2017)

SAFETY DATA SHEET

Acryloyl chloride

Revision Date: 14-Feb-2020

Revision Date: 14-Feb-2020

Revision Number: 3

Acryloyl chloride

Revision Date: 14-Feb-2020

Class:
This is:

Flammable
Acute
Skin 2
Serious
Target
Label:

Signal
Danger

Hazard
GHS05
Harmful

Causes
Eye Irrit.
Fatal F+H

Precise
Prevent
Wish to
Do not
Do not
Wear
Keep on
Ground
Use only
Take up
Resistor

Inhalation
Skin
Eye
Wish to
Do not
In E.N.
Ingest
Fire
Risk
In case
Storage
Skin
Disposal
Hazard

Personal Precautions

6. Accidental release measures

Ensure adequate ventilation. Use personal protective equipment as required. Evacuate personnel to safe areas. Keep people away from upwind of spill/haze. Remove all sources of ignition. Take precautionary measures against static discharges.

Environmental Precautions

Should not be released into the environment. See Section 12 for additional Ecological Information.

Methods for Containment and Clean Up

Soak up with inert absorbent material. Keep in suitable, closed containers for disposal. Do not expose spill to water. Remove all sources of ignition. Use spark-proof tools and explosion-proof equipment.

Handling

7. Handling and storage

Wear personal protective equipment/face protection. Do not get in eyes, on skin, or on clothing. Use only under a chemical fume hood. Do not breathe mist/vapour/dust. Do not ingest. If swallowed then seek immediate medical assistance. Do not allow contact with water. Handle under an inert atmosphere. Keep away from open flames, hot surfaces and sources of ignition. Use only non-sparking tools. To avoid ignition of vapour by static electricity discharge, all metal parts of the equipment must be grounded. Take precautionary measures against static discharges.

Storage

Corrosives area. Keep away from heat, sparks and flame. Store under an inert atmosphere. Protect from moisture. Keep containers tightly closed in a dry, cool and well-ventilated place. Keep away from water or moist air.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH REL	Mexico OEL (TWA)
Phenothiazine	TWA: 5 mg/m ³ Skin	(Vacated) TWA: 5 mg/m ³ Skin	TWA: 5 mg/m ³	TWA: 5 mg/m ³

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH (REL) - NIOSH - National Institute for Occupational Safety and Health

Engineering Measures

Ensure that eyewash stations and safety showers are close to the workstation location. Ensure adequate ventilation, especially in confined areas. Use explosion-proof electrical/ventilating/lighting equipment.

Personal Protective Equipment

Eye/Face Protection

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection

Wear appropriate protective gloves and clothing to prevent skin exposure.

Respiratory Protection

Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 148. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Hygiene Measures

Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

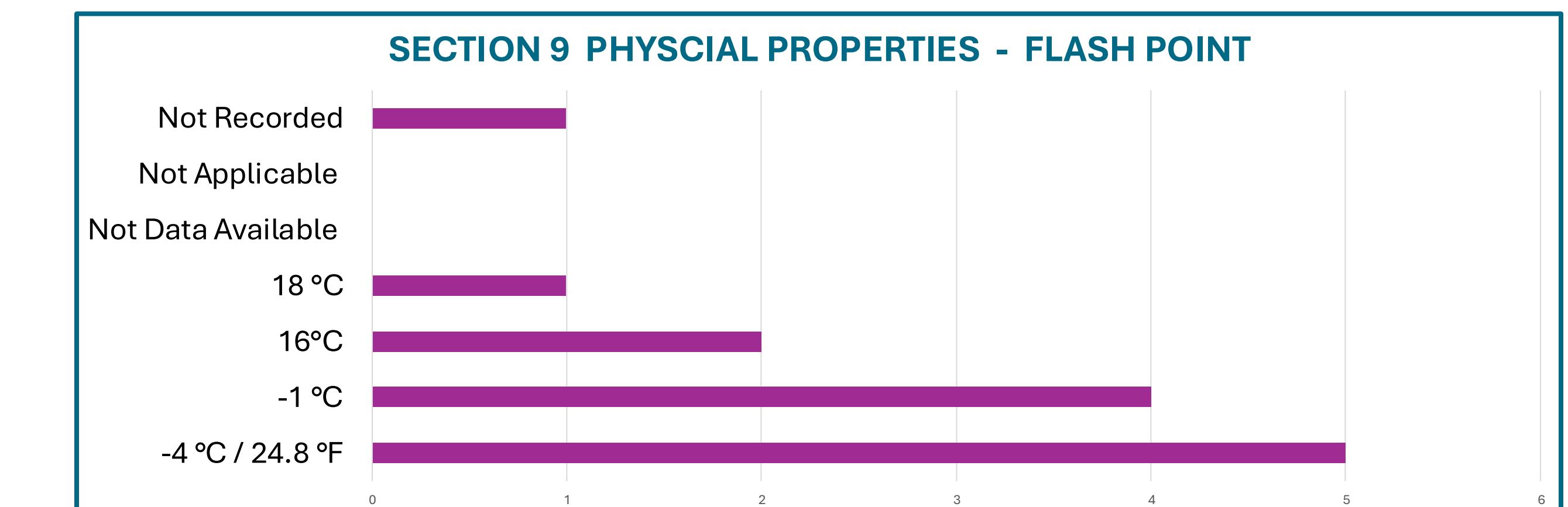
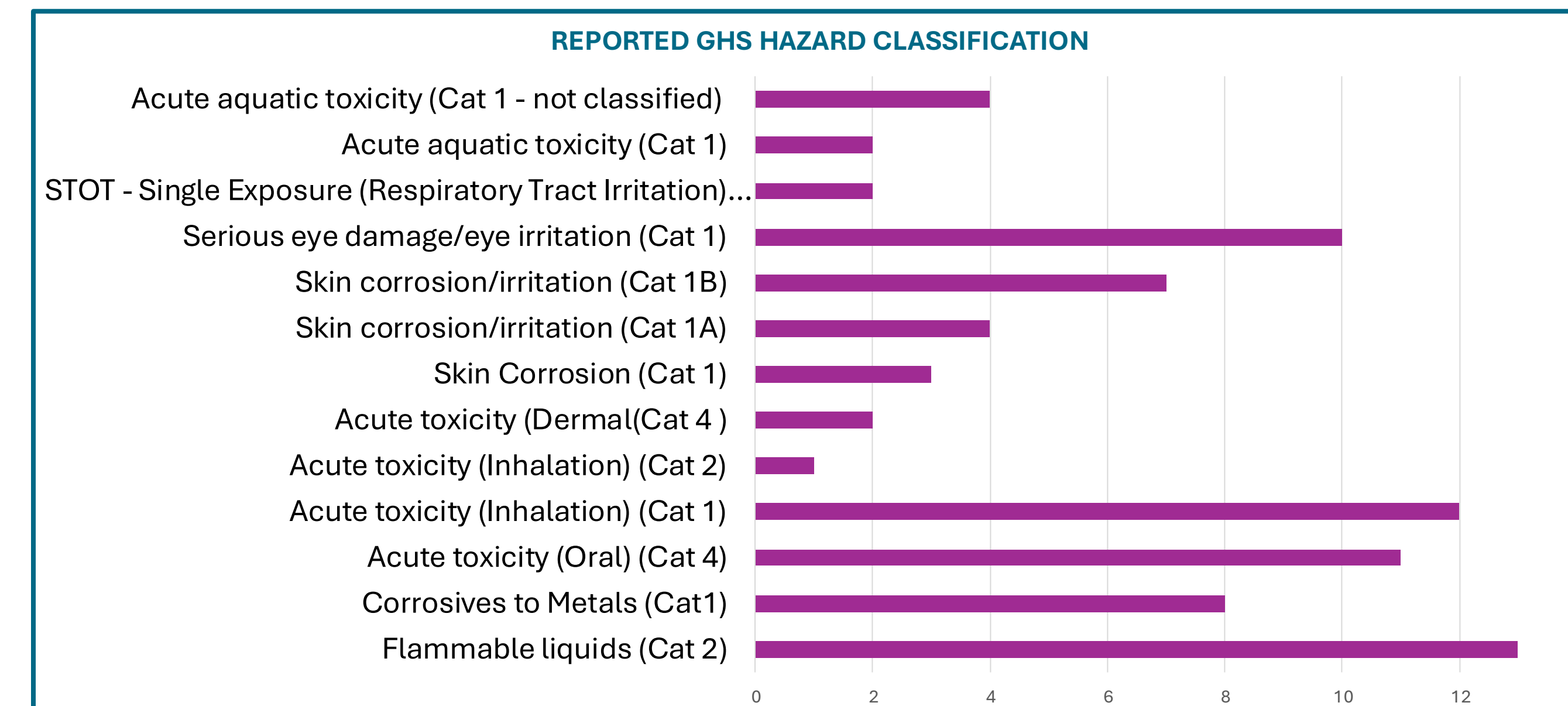
Physical State

Liquid

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Image Source: Pathan et al. 2022

RESULTS



CONCLUSION



The inconsistencies found across all SDSs for a single chemical substance raise concerns about the quality of information incorporated into the SDS authors' use, the thoroughness of their research, data availability, and the authoring process.

The research found that the statement in the published SDS was not a misinterpretation, but rather one of many inconclusive statements that led the reader, safety professional, and emergency professionals to make their own decisions regarding their safety.