Comité Technique Européen du Fluor (CTEF)

Working Group on

Storage, Transport and Safety (STS)

GPS Summary for Anhydrous Hydrogen Fluoride and Hydrofluoric Acid

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SUBSTANCE NAME

Hydrogen Fluoride, Anhydrous Hydrofluoric Acid, Hydrofluoric Acid

GENERAL STATEMENT

This Product Safety Summary is a general overview of the chemical substance. There is no in-depth information about emergency response information, medical information or treatment information, as it is basic information. For these purposes and other information please see www.eurofluor.org. For safety and health information it is intended to use the extended Safety Data Sheet (eSDS) for the chemical substance, which is provided by the supplier of the substance.

Hydrofluoric acid is both corrosive and very toxic. Exposures require very specific first aid treatment in order to avoid any health effects up to death.

Hydrogen fluoride, (HF), better known as hydrofluoric acid, is one of the basic raw materials for a wide variety of both commercial and industrial products.
It is produced by reacting a naturally occurring mineral, fluorspar, with sulphuric acid. HF is a strongly corrosive and very toxic acid which must be handled with extreme caution. Safety is therefore the primary concern of both producers and users.

CHEMICAL IDENTITY

Name	Hydrogen Fluoride
CAS number(s)	7664-39-3
ES number (optional)	231-634-8
Molecular formula (optional)	FH
Structure (optional)	H-F

USES AND APPLICATIONS

There is no use of this substance for consumers.

Anhydrous hydrogen fluoride is used in the production of organic fluoride compounds and inorganic fluorides such as hydrofluorocarbons, hydrofluorochlorocarbons and fluoropolymers. Other uses of anhydrous fluoride include as a catalyst for alkylation reactions.

Aqueous hydrofluoric acid is used in stainless steel pickling, glass etching, metal coatings and metal extraction.

The quantitative estimate for the industrial and use category distribution of HF is approximately 90% as an intermediate which is used for the synthesis of organic fluoride compounds (60%) and inorganic fluorides (30%). Approximately 8% is used in the mining, enrichment, purification of minerals, metals and minerals which includes 5% as a pickling agent of metal surfaces and 3% for etching of glass surfaces. Hydrogen fluoride is also used as a catalyst in alkylation reactions in the petrochemical

industry which contributes to 1% of the manufactured hydrogen fluoride. The remaining quantities are used in the construction industry, industrial cleaning, solar industry and passivation of metal surfaces.

PHYSICAL/CHEMICAL PROPERTIES

Phys/Chem Safety Assessment

Hydrogen fluoride is a colourless gas, which fumes on contact with air and is completely miscible with water. It has a boiling point of 19,5 to 20°C and a melting point of -83,37 to -83,86°C. The ideal gas density of the substance is reported to be 0,818 g/L at 25°C and 0,97 at 20°C. The vapour pressure is reported to be 122 kPa (917 mmHg) at 25°C. For the liquefied form, the density and viscosity are reported to be 1,002-1,02 g/L and 0,256 mPa. s at 0°C respectively. The surface tension has been measured to be 10,2 mN/m at 0°C.

Property	Value
Form	Gas
Physical state	at room temperature: gas, liquefied at below 19,5°C: fuming liquid
Colour	colourless
Odour	pungent
Density	at 20°C: 0,97 g/mL at 30°C: 0,95 g/mL at 40°C: 0,93 g/mL at 50°C: 0,91 g/mL
Melting / boiling point	Boiling temperature / boiling range 19,5°C Melting point / melting range -83,4°C
Flammability (optional)	Non-flammable.
Explosive properties	The substance does not contain any groups associated with explosive properties. The substance is also non-combustible
Self-ignition temperature	The assessment of auto flammability is technically not feasible.
Vapour pressure	at 20°C: 1053 hPa at 30°C: 1466 hPa at 40°C: 2053 hPa at 50°C: 2733 hPa
Mol weight	20,01 g/mol
Water solubility	fully miscible
Flash point	not combustible
Octanol-water partition coefficient (LogKow)	the substance is an inorganic gas at room temperature and pressure

HEALTH EFFECTS

Human Health Safety Assessment

Hydrogen fluoride is classified according to the CLP Regulation (EC) 1272/2008 in Acute Toxicity Category 2 (H300, H330), Acute Toxicity Category 1 (H310) and skin corrosion/irritation Category 1a (H314).

- **Consumer**: consumer exposure is very unlikely as the substance is manufactured and handled in industrial settings in closed systems.
- **Worker**: Workers will not come into contact with HF, as the substance is manufactured and handled in industrial settings in closed systems. In case of unintended exposure during maintenance, sampling, testing, or other procedures workers should follow the recommended safety measures in the Extended Safety Data Sheet (eSDS).

Effect Assessment	Result
Acute Toxicity Oral / inhalation / dermal	H300: fatal if swallowed H310: fatal if contact with the skin H330: fatal if inhaled (T+; R26/27/28 Very toxic by inhalation, in contact with skin and if swallowed.)
Irritation / corrosion Skin / eye/ respiratory tract	H314: Causes severe skin burns and eye damage May cause respiratory irritation. (C; R35 Causes severe burns)
Sensitisation	There are no animal data which suggest that HF or fluoride are skin sensitizers; the local effects of HF exposure will be dominated irritation/corrosion. Similarly there is no evidence of skin sensitization from occupational exposure; reports of delayed dermal effects in some accidental exposures cases are due to irritancy rather than sensitisation. Similarly there is no evidence of respiratory sensitisation (asthma) from occupational exposure.
Toxicity after repeated exposure Oral / inhalation / dermal	Effects of repeated fluoride exposure in experimental animals were seen on the teeth, bones, respiratory tract and kidneys. Evidences from epidemiological studies in humans also indicate that prolonged exposure to fluoride causes dental and skeletal effects.
Genotoxicity / Mutagenicity	not mutagenic; HF and fluoride do not interact directly with DNA and is not genotoxic when administered via an appropriate route (i.e. by oral or inhalation exposure).
Carcinogenicity	not considered as carcinogenic based on oral and dermal data; No classification is proposed. The EU RAR has reviewed all available data for HF and NaF and concludes that the data are sufficient to suggest that fluoride is not carcinogenic in animals.
Toxicity for reproduction	based on available data no developmental toxicity or reprotoxicity be anticipated; Reliable studies do not indicate any developmental toxicity or reproductive toxicity of fluoride. No classification is therefore proposed.

ENVIRONMENTAL EFFECTS

Environment Safety Assessment

HF is a simple inorganic substance which will rapidly ionise in the environment and will not be subject to biodegradation.

Effect Assessment	Result
Aquatic Toxicity	Toxic effect on fishes and plankton. Harmful effects by modification of pH-value. Forms corrosive mixtures with water even if diluted. Water Hazard Class: 2 = hazardous to water (WGK catalog number 254)

Fate and behaviour	Result
Biodegradation	No biodegradation of HF will occur.
Bioaccumulation potential	HF does not bioaccumulate as such. In the terrestrial environment, fluorides accumulate in the skeleton of vertebrates and in invertebrates.
PBT / vPvB conclusion	The substance is not considered to be persistent, bioaccumulating or toxic (for environment) (PBT), nor very persistent and very bioaccumulating (vPvB).

EXPOSURE

Human health

Hydrogen fluoride is predominantly produced under controlled conditions in contained systems with little or no potential for exposure to operators (use in closed process, no likelihood of exposure). The finished product is obtained via condensation and purification of the vapours produced when mineral fluorite and concentrated sulphuric acid are mixed together. At room temperature, anhydrous hydrogen fluoride is a gas so it is essential that production and transferral all occur in a closed system. The hydrogen fluoride produced is either transferred to large and small containers for transportation or piped to another part of the factory for immediate use (transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities and transfer of substance or preparation into small containers (dedicated filling line, including weighing)). Small leakages may occur which could cause potential inhalation and dermal exposure. The use of engineering controls to prevent leakage of HF is normal procedure.

Consumers will not come into contact with HF as it is manufactured in a closed process which also minimizes employee exposure potential. Exposure to HF of personnel in manufacturing facilities is also considered very low because the process, storage and handling operations are in closed systems. Workers who might accidentally come in contact with the substance should follow the safety measures recommended in the Extended Safety Data Sheet (eSDS).

Environment

The manufacture is a closed and automated process with no aqueous effluent neither gaseous effluent released to the environment. During the industrial use of the substance there is also a "No release" policy with all effluent being stored in special containers dedicated to incineration.

Releases to the environment are minimal. Atmospheric releases are kept to a minimum by the use of scrubbers. Waste water emissions are kept low by the use of an efficient waste water treatment involving neutralisation followed by precipitation of fluoride as insoluble calcium fluoride. Uptake of fluoride via the soil or atmosphere is therefore not predicted.

RISK MANAGEMENT RECOMMENDATIONS

Exposure controls

Transfer and handle product only in closed systems.

In case of spill or release: Withdraw by suction.

Occupational exposure controls

- Respiratory protection: Respiratory protection must be worn whenever the WEL (Workplace Exposure Limit) levels may be exceeded.
- Use filter type E-(P2/P3) according to EN 141. Possible alternatives: filter B-(P2).
- Carry along escape equipment (self rescuer). Have a breathing apparatus that is not dependent on the circulating air ready for emergencies.
- Hand protection: Liquid: protective gloves according to EN 374 and suitable for HF
- Observe glove manufacturer's instructions concerning penetrability and breakthrough time.
- Protective gloves have to be replaced at the first sign of deterioration.
- Eye protection: Tightly sealed safety glasses according to EN 166.
- In case of increased risk, additionally wear face protective shield.
- Body protection: Acid-proof protective clothing, boots.
- In case of handling larger quantities: Wear full protective gear.
- General protection and hygiene measures:
    - When using do not eat or drink.
    - Take off immediately all contaminated clothing.
    - Wash hands before breaks and after work.
- Safety shower and eye wash station should be easily accessible to the work area.

STATE AGENCY REVIEW

This substance has been registered under REACH (CE) 1907/2006

REGULATORY INFORMATION / CLASSIFICATION AND LABELLING

Classification according to EC regulation 1272/2008 (CLP):

Skin Corr. 1A; H314 Causes severe skin burns and eye damage.

Acute Tox. 2; H330 Fatal if inhaled.

Acute Tox. 1; H310 Fatal in contact with skin.

Acute Tox. 2; H300 Fatal if swallowed.

Classification according to directive 67/548/EEC:

T+; R26/27/28 Very toxic by inhalation, in contact with skin and if swallowed.

C; R35 Causes severe burns.

Label elements

Labelling (CLP)

Signal word **Danger**

Hazard Statements

- H300 Fatal if swallowed.
- H310 Fatal in contact with skin.
- H314 Causes severe skin burns and eye damage.
- H330 Fatal if inhaled.

Safety precautions

- P260 Do not breathe fume/gas/mist/vapours/spray.
- P280 Wear protective gloves/protective clothing/eye protection/face protection.
- P301+P330+P331 IF SWALLOWED: rinse mouth. Do NOT induce vomiting.

- P303+P361+P353 IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing.
- P304+P340 IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
- P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
- P310 Immediately call a POISON CENTER or doctor/ physician.
- P403+P233 Store in a well-ventilated place. Keep container tightly closed.
- P501 Dispose of contents/container to hazardous or special waste collection point.

Labelling (67/548/EEC or 1999/45/EC)

T+

very toxic

C

Corrosive

- R phrase(s): R 26/27/28 Very toxic by inhalation, in contact with skin and if swallowed.
- R 35 Causes severe burns.
- S 7/9 Keep container tightly closed and in a well-ventilated place.
- S 26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
- S 36/37/39 Wear suitable protective clothing, gloves and eye/face protection.
- S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

Other hazards

Container under pressure. Heating causes rise in pressure with risk of bursting.

CONCLUSION

Hydrofluoric acid is corrosive and very toxic. Exposures require immediately and very specific first aid treatment in order to neutralize the fluoride ion. If the a hydrofluoric acid exposure is not treated immediately and proper, it can result in serious health effects up to and including death.

CONTACT INFORMATION

For further information on this substance or product safety summaries in general, please contact the

Comité Technique Européen du Fluor (CTEF), a **Cefic Sector Group**,
at info@eurofluor.org or/and visit www.eurofluor.org.

GLOSSARY

Acute toxicity	Harmful effect resulting from a single or short term exposure to a substance
Biodegradation	Decomposition or breakdown of a substance under natural conditions (actions of micro organisms etc)
Bioaccumulation	Progressive accumulation in living organisms of a chemical substance present in the environment
Carcinogenicity	Substance effects causing cancer
Chronic toxicity	Harmful effect after repeated exposures or long term exposure to a substance
Clastogenicity	Substance effect that causes breaks in chromosomes
Embryotoxicity	Harmful effect on foetal health
Flash point	The lowest temperature at which vapour of the substance may form a ignitable mixture with air
Genotoxicity	Substance effect that causes damage to genes, including Mutagenicity and clastogenicity
GHS	Global Harmonized System of chemicals classification
Hazard	Inherent substance property bearing a threat to health or environmen
Mutagenicity	Substance effect that cause mutation on genes
Persistence	Refers to the length of time a compound stays in the environment, on introduced
Reprotoxicity	Including teratogenicity, embryotoxicity and harmful effects on fertilit
Sensitising	Allergenic
Sediment	Topsoil, sand and minerals washed from land into water forming in th end a layer at the bottom of rivers and sea
Teratogenic	Substance effect on foetal morphology
Vapour pressure	A measure of a substance's property to evaporate
Volatile	Any substance that evaporates readily

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REVISION

ADDITIONAL INFORMATION

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