

## Fluorine or compounds thereof

### Definition of causal agent

At ambient pressure and temperature, fluorine is a corrosive pale greenish-yellow gas with a bitter smell. It is highly reactive and combines with practically all other organic and inorganic substances with the exception of nitrogen and oxygen. It reacts with water to form hydrofluoric acid.

Hydrofluoric acid (synonyms: fluorohydric acid, anhydrous hydrofluoric acid, hydrogen fluoride) is a highly volatile, colourless gas or liquid, very soluble in water and has a bitter smell.

### *Main occupational uses and sources of exposure:*

Fluorine: Synthesis of organic and inorganic fluorine compounds; oxidizer in rocket fuel.

Hydrofluoric acid: Production of organic and inorganic fluorine compounds; catalyst (particularly in paraffin alkylation in the petroleum industry); insecticide; arrest of fermentation in brewing; fluorination processes; removing sand from metallic castings; glass polishing; frosting and etching glass and enamel; decomposing enamel.

Fluorides: electrolyte in aluminium manufacture; flux in smelting nickel, copper, gold, silver; catalyst for organic reactions; fluoridation agent for drinking water; bleaching agent; insecticides, rodenticides; fermentation inhibitor; cleaning graphite, metals, windows, glassware; preparation of fertilizer from phosphate rock by addition of sulphuric acid.

## Toxic effects

### I. Fluorine and hydrogen fluoride

#### *Local effects*

#### Irritant and corrosive effects

Fluorine and hydrofluoric acid are particularly irritating to the skin, eyes and respiratory tract (possibility of bronchospasm, laryngospasm and acute pneumonitis, pulmonary oedema in the event of massive exposure).

Epistaxis and sinus trouble may develop on low chronic exposure to these compounds.

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Cutaneous contact with hydrofluoric acid may lead to extremely painful burns. The chemical burns cause deep tissue destruction and may become symptomatic until several hours after contact, depending on the dilution.

Possibility of developing systemic symptoms by hypocalcaemia caused by binding of fluoride ions to calcium ions following skin absorption from burn sites.

See section on *Occupationally caused irritation of the skin and mucous membranes* in Annex I entry nr. 202.

***Exposure criteria:***

*Minimum intensity of exposure:* Occupational exposure confirmed, if possible assessed by:

- Anamnesis and study of exposure conditions providing evidence of skin contact or inhalation.
- And if available:
  - Workplace air monitoring:  
Guide values:  
Fluorine: atmospheric concentrations well above 3.16 mg/m<sup>3</sup> (2 ppm)  
Hydrogen Fluoride: atmospheric concentrations well above 2.5 mg/m<sup>3</sup> (3 ppm)

*Minimum duration of exposure:* seconds to minutes

*Maximum latent period:* The first manifestations should appear during exposure or within a few hours.

## **II. Inorganic fluoride compounds**

### *Local effects*

#### **□ Irritant effects**

Some inorganic fluoride compounds are irritating to the skin, eyes and respiratory tract. Epistaxis and sinus trouble may develop on the low chronic exposure to fluorides.

Fluorides are suspected to be one of the causal agents of 'potroom asthma' in workers of the aluminium manufacturing industry

***Exposure criteria:***

*Minimum intensity of exposure*

- Occupational exposure confirmed, if possible assessed by history and study of exposure conditions providing evidence of skin contact or inhalation.
- And if available: Workplace air monitoring:  
Guide values: atmospheric concentration above 2.5 mg/m<sup>3</sup> of fluorine ions

*Minimum duration of exposure:* Seconds to minutes depending on the intensity of the exposure

*Maximum latent period:* The first manifestations should appear during exposure or within a few hours

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## □ Systemic effects

*Skeletal fluorosis:* Excessive absorption of fluorides may result in osteosclerosis; that is recognizable by X-ray (first signs of changes in density appearing in the lumbar spine and pelvis). Usually some ossification of ligaments occurs.

### *Exposure criteria:*

*Minimum intensity of exposure:* Occupational exposure confirmed if possible assessed by:

- Anamnesis and study of the working conditions showing evidence of excessive and prolonged or repeated exposure to inorganic fluoride dusts or vapours.
- And, if available:
  - Biological monitoring: Significant increase in the urinary level of fluoride during the working day. For exposed workers; urine fluoride should be less than 4 mg/l, when taken in pre-shift samples; and less than 8 mg/l when taken in post shift samples. Other non occupational sources of fluoride intake should be checked. Workers not presently exposed but having had fluorosis do not usually have elevated urine fluoride values.
  - Workplace air monitoring:  
Guide value:  
Atmospheric concentration above 2.5 mg/m<sup>3</sup> of fluorine ions

*Minimum duration of exposure:* One year.

*Maximum latent period:* One year