

INORGANIC FLUORIDES

Provided by Bruce Hope and Dave Stone.

October 21, 2015 – ATSAC Meeting #10

INORGANIC FLUORIDES

- ▶ Fluorine (F_2) – CAS 7782-41-4 **{highly reactive}**
- ▶ Inorganic fluoride compounds
 - ▶ Hydrogen fluoride (gaseous HF) – CAS 7664-39-3
 - ▶ Hydrofluoric acid (aqueous HF)
 - ▶ Sodium fluoride (NaF) – CAS 7681-49-4 {moderate S}
 - ▶ Calcium fluoride (CaF_2) – CAS 7789-75-5 {low S}
 - ▶ Sulphur hexafluoride (SF_6) – CAS 2551-62-4 {inert}
- ▶ Fluoride anion (F^-) – CAS 16984-48-8
 - ▶ Basis for toxicity; as a function of solubility
 - ▶ Measurement of fluoride restricted to free ion

9	$2P_{3/2}$ $1s2s2p_6$
F	
Fluorine	
18.9984032	

ATMOSPHERIC FLUORIDES

- ▶ Hydrogen fluoride (75%)
 - ▶ $\text{HF} + \text{H}_2\text{O} \rightarrow$ Hydrofluoric acid aerosol
 - ▶ Eliminated via wet & dry deposition
 - ▶ Atmospheric half-life: ~12-14 hours (wet-dry)
- ▶ Inorganic fluoride particulates/aerosols (25%)
 - ▶ Condensation and nucleation processes
 - ▶ Eliminated via wet & dry deposition
 - ▶ Atmospheric half-life: ~12 days (dry); ~50 hours (wet)

AIR CONCENTRATIONS

- ▶ Gaseous & particulate sources
 - ▶ Volcanos / soils / sea salt
 - ▶ Coal-fired electrical utilities
 - ▶ Primary aluminum smelters
 - ▶ Phosphate fertilizer production
 - ▶ Steel & ceramic (brick, tile) production
- ▶ Ambient levels
 - ▶ Non-urban areas (US): $< 0.05 \mu\text{g}/\text{m}^3$
 - ▶ Urban areas (US/Canada): 0.01 to $1.65 \mu\text{g}/\text{m}^3$
 - ▶ Heavily industrialized urban areas: ~ 2 to $3 \mu\text{g}/\text{m}^3$

FLUORIDE INTAKE (HUMAN)

- ▶ Estimates of TDI in adults (ECB, 2002)
 - ▶ Food and drinking water: 5640 $\mu\text{g F/day}$
 - ▶ Toothpaste: 300 $\mu\text{g F/day}$
 - ▶ Air 50 $\mu\text{g F/day}$
- ▶ Inhalation contribution to TDI is ~2 orders of magnitude lower than drinking water and food combined
- ▶ In the US, airborne exposure is low compared to ingested fluoride; exceptions include heavily industrialized areas or occupational exposures

HUMAN TOXICITY

- ▶ Respiratory tract irritation and inflammation is primary endpoint for acute exposure
- ▶ Chronic inhalation (as HF or dusts) endpoint is skeletal fluorosis
- ▶ Significant but unclear database on genotoxicity
 - ▶ Positive at doses highly toxic to cells and whole animals; negative at lower doses
 - ▶ No specific epidemiologic (human) evidence of potential for carcinogenic effects
 - ▶ Not evaluated by USEPA or IARC (3)
 - ▶ Lack data for quantitative assessment (URE)