MATERIAL SAFETY DATA SHEET

1. Product and Company Identification

Material name: BUFFERED OXIDE ETCH
Version #: 03
Revision date: 08-26-2011
CAS #: Mixture
Product Codes: J.T.Baker: 1178, 1188, 1198, 5109, 5173, 5175, 5192, 5326, 5329, 5361, 5521, 5540, 5554, 9294, 9354
Synonym(s): Aqueous NH₄HF Etchant Solutions
Manufacturer: Avantor Performance Materials, Inc.
Address: 3477 Corporate Parkway
Suite #200
Center Valley, PA 18034
US
Customer Service: 855-282-6867
24 Hour Emergency: 908-859-2151
Chemtrec: 800-424-9300

2. Hazards Identification

Emergency overview
DANGER
Corrosive. Causes severe skin and eye burns. Causes digestive tract burns. May be fatal if inhaled, absorbed through skin, or swallowed. Mist or vapor extremely irritating to eyes and respiratory tract. Causes blood, cardiovascular system and respiratory system damage. Prolonged exposure may cause chronic effects. Reacts with water.

OSHA regulatory status
This product is considered hazardous under 29 CFR 1910.1200 (Hazard Communication).

Potential health effects

<table>
<thead>
<tr>
<th>Routes of exposure</th>
<th>Eyes</th>
<th>Skin</th>
<th>Inhalation</th>
<th>Ingestion</th>
<th>Target organs</th>
<th>Chronic effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ingestion. Inhalation. Skin contact. Eye contact.</td>
<td>Corrosive. Causes severe eye burns. Vapor or spray may cause eye damage, impaired sight or blindness.</td>
<td>Corrosive. Causes severe skin burns. This product may be fatal if it is absorbed through the skin. The fluoride ion readily penetrates the skin causing destruction of deep tissue layers and even bone. Symptoms may develop after several hours.</td>
<td>May be harmful if inhaled. Corrosive. May cause damage to mucous membranes in nose, throat, lungs and bronchial system.</td>
<td>Corrosive. May be fatal if swallowed. Ingestion may produce burns to the lips, oral cavity, upper airway, esophagus and possibly the digestive tract.</td>
<td>Eyes. Skin. Respiratory system. Blood. Heart and cardiovascular system. Teeth. Bone. Endocrine system.</td>
<td>Corrosive. Prolonged contact causes serious tissue damage. Intake of more than 6 mg of fluorine per day may result in fluorosis, bone and joint damage. Hypocalcemia and hypomagnesemia can occur from absorption of fluoride ion into blood stream. Symptoms may be delayed.</td>
</tr>
</tbody>
</table>

Target organs


Chronic effects

Corrosive. Prolonged contact causes serious tissue damage. Intake of more than 6 mg of fluorine per day may result in fluorosis, bone and joint damage. Hypocalcemia and hypomagnesemia can occur from absorption of fluoride ion into blood stream. Symptoms may be delayed.

Potential environmental effects

The product may affect the acidity (pH-factor) in water with risk of harmful effects to aquatic organisms.

3. Composition / Information on Ingredients

<table>
<thead>
<tr>
<th>Hazardous components</th>
<th>CAS #</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMMONIUM FLUORIDE</td>
<td>12125-01-8</td>
<td>30 - 40</td>
</tr>
</tbody>
</table>
4. First Aid Measures

First aid procedures

**Eye contact**
Immediately flush with plenty of water for at least 15 minutes. If easy to do, remove contact lenses. Call a physician or poison control center immediately. In case of irritation from airborne exposure, move to fresh air. Get medical attention immediately.

**Skin contact**
Immediately flush with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician or poison control center immediately. Wash clothing separately before reuse. Destroy or thoroughly clean contaminated shoes.

**Inhalation**
Move to fresh air. If breathing stops, provide artificial respiration. If breathing is difficult, give oxygen. Call a physician or poison control center immediately.

**Ingestion**
Call a physician or poison control center immediately. Do not induce vomiting. If vomiting occurs, the head should be kept low so that stomach vomit doesn't enter the lungs.

**Notes to physician**
Keep victim under observation. Appropriate treatment to help protect the affected person against circulatory shock, respiratory depression, and convulsion may be needed. Symptoms may be delayed.

**General advice**
In the case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). Show this safety data sheet to the doctor in attendance. Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

5. Fire Fighting Measures

**Flammable properties**
The product is not flammable. Material will react with water and may release a flammable (and/or) toxic gas.

**Extinguishing media**
- **Suitable extinguishing media**
  Carbon dioxide (CO2). Dry chemical powder. Foam.
- **Unsuitable extinguishing media**
The product reacts with water and will generate heat. Addition of water or foam to the fire may cause frothing.

**Protection of firefighters**
- **Specific hazards arising from the chemical**
  Not flammable, but reacts with most metals to form flammable hydrogen gas. Fire may produce irritating, corrosive and/or toxic gases.

**Protective equipment and precautions for firefighters**
Self-contained breathing apparatus and full protective clothing must be worn in case of fire. Use water spray to cool unopened containers. Cool containers exposed to flames with water until well after the fire is out.

**Special protective equipment for fire-fighters**
Wear full protective clothing, including helmet, self-contained positive pressure or pressure demand breathing apparatus, protective clothing and face mask. Wear self-contained breathing apparatus with a full facepiece operated in the positive pressure demand mode when fighting fires.

**Specific methods**
In the event of fire and/or explosion do not breathe fumes.

6. Accidental Release Measures

**Personal precautions**
Wear appropriate protective equipment and clothing during clean-up. Keep unnecessary personnel away. Keep upwind. Keep out of low areas. Ventilate closed spaces before entering them. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Local authorities should be advised if significant spillages cannot be contained.

**Environmental precautions**
Prevent further leakage or spillage if safe to do so. Do not contaminate water. Avoid discharge into drains, water courses or onto the ground.
Methods for containment

Stop the flow of material, if this is without risk. Prevent entry into waterways, sewer, basements or confined areas. Dike the spilled material, where this is possible.

Methods for cleaning up

Large Spills: Neutralize spill area and washings with soda ash or lime. Use a non-combustible material like vermiculite, sand or earth to soak up the product and place into a container for later disposal. Dike far ahead of spill for later disposal.

Small Spills: Neutralize spill area and washings with soda ash or lime. Wipe up with absorbent material (e.g. cloth, fleece). Collect in a non-combustible container for prompt disposal.

Never return spills in original containers for re-use. Clean surface thoroughly to remove residual contamination. Clean up in accordance with all applicable regulations.

7. Handling and Storage

Handling

Wear appropriate personal protective equipment. Do not get in eyes, on skin, on clothing. Do not breathe mist or vapor. Do not taste or swallow. Use only with adequate ventilation. Wash thoroughly after handling. Do not eat, drink or smoke when using the product. Use caution when combining with water; DO NOT add water to acid, ALWAYS add acid to water while stirring to prevent release of heat, steam and fumes. See Section 8 of the MSDS for Personal Protective Equipment.

Storage

Do not store in metal containers. Keep tightly closed in a dry, cool and well-ventilated place.

8. Exposure Controls / Personal Protection

ACGIH

<table>
<thead>
<tr>
<th>Components</th>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMMONIUM FLUORIDE (12125-01-8)</td>
<td>BEL</td>
<td>3.0000 mg/g</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10.0000 mg/g</td>
</tr>
<tr>
<td></td>
<td>TWA</td>
<td>2.5000 mg/m3</td>
</tr>
<tr>
<td>HYDROFLUORIC ACID (7664-39-3)</td>
<td>BEL</td>
<td>3.0000 mg/g</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10.0000 mg/g</td>
</tr>
<tr>
<td></td>
<td>Ceiling</td>
<td>2.0000 ppm</td>
</tr>
<tr>
<td></td>
<td>TWA</td>
<td>2.5000 mg/m3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.5000 ppm</td>
</tr>
</tbody>
</table>

Occupational exposure limits

<table>
<thead>
<tr>
<th>U.S. - OSHA</th>
<th>Components</th>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AMMONIUM FLUORIDE (12125-01-8)</td>
<td>PEL</td>
<td>2.5000 mg/m3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TWA</td>
<td>2.5000 mg/m3</td>
</tr>
<tr>
<td></td>
<td>HYDROFLUORIC ACID (7664-39-3)</td>
<td>PEL</td>
<td>2.5000 mg/m3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TWA</td>
<td>3.0000 ppm</td>
</tr>
</tbody>
</table>

Engineering controls

Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level.

Personal protective equipment

Eye / face protection

Wear safety glasses with side shields (or goggles) and a face shield.

Skin protection

Wear appropriate chemical resistant clothing. Wear appropriate chemical resistant gloves.

Respiratory protection

If engineering controls do not maintain airborne concentrations below recommended exposure limits (where applicable) or to an acceptable level (in countries where exposure limits have not been established), an approved respirator must be worn. Chemical respirator with specific cartridge and full facepiece providing protection against the compound of concern.

General hygiene considerations

Provide eyewash station and safety shower. Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.
General
Wear chemical protective equipment that is specifically recommended by the manufacturer.
Launder contaminated clothing before reuse.

9. Physical & Chemical Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Clear</td>
</tr>
<tr>
<td>Color</td>
<td>Colorless</td>
</tr>
<tr>
<td>Odor</td>
<td>Not available</td>
</tr>
<tr>
<td>Odor threshold</td>
<td>Not available</td>
</tr>
<tr>
<td>Physical state</td>
<td>Liquid</td>
</tr>
<tr>
<td>Form</td>
<td>Liquid</td>
</tr>
<tr>
<td>pH</td>
<td>1 (0.1 M HF)</td>
</tr>
<tr>
<td>Melting point</td>
<td>64.4 °F (18 °C)</td>
</tr>
<tr>
<td>Freezing point</td>
<td>64.4 °F (18 °C)</td>
</tr>
<tr>
<td>Flash point</td>
<td>Not available</td>
</tr>
<tr>
<td>Evaporation rate</td>
<td>Not available</td>
</tr>
<tr>
<td>Flammability limits in air, upper, % by volume</td>
<td>Not available</td>
</tr>
<tr>
<td>Flammability limits in air, lower, % by volume</td>
<td>Not available</td>
</tr>
<tr>
<td>Vapor density</td>
<td>Not available</td>
</tr>
<tr>
<td>Specific gravity</td>
<td>1.1</td>
</tr>
<tr>
<td>Relative density</td>
<td>Not available</td>
</tr>
<tr>
<td>Solubility (water)</td>
<td>Not available</td>
</tr>
<tr>
<td>Partition coefficient</td>
<td>Not available</td>
</tr>
<tr>
<td>(n-octanol/water)</td>
<td></td>
</tr>
<tr>
<td>Auto-ignition temperature</td>
<td>Not available</td>
</tr>
<tr>
<td>Decomposition temperature</td>
<td>Not available</td>
</tr>
</tbody>
</table>

10. Chemical Stability & Reactivity Information

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical stability</td>
<td>Stable under normal temperature conditions. Instability caused by elevated temperatures.</td>
</tr>
<tr>
<td>Conditions to avoid</td>
<td>Heat. Water, moisture.</td>
</tr>
<tr>
<td>Possibility of hazardous reactions</td>
<td>Hazardous polymerization does not occur.</td>
</tr>
</tbody>
</table>

11. Toxicological Information

<table>
<thead>
<tr>
<th>Toxicological data</th>
<th>Test Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product</td>
<td>Acute Dermal LD50 Rabbit: 51.73 mg/kg</td>
</tr>
<tr>
<td></td>
<td>Acute Inhalation LC50 Rat: 0.385 mg/l 4.00 hours</td>
</tr>
<tr>
<td></td>
<td>Acute Oral LD50 Rat: 45.45 mg/kg</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sensitization</th>
<th>Not a skin sensitizer.</th>
</tr>
</thead>
<tbody>
<tr>
<td>US ACGIH Threshold Limit Values: Skin designation</td>
<td>Can be absorbed through the skin.</td>
</tr>
<tr>
<td>ACUTE EFFECTS</td>
<td>May be fatal if inhaled, absorbed through skin, or swallowed.</td>
</tr>
</tbody>
</table>
Local effects
Causes severe burns. Mist or vapor extremely irritating to eyes and respiratory tract. Causes blood, cardiovascular system and respiratory system damage.

Chronic effects
Corrosive. Prolonged contact causes serious tissue damage. Intake of more than 6 mg of fluorine per day may result in fluorosis, bone and joint damage. Hypocalcemia and hypomagnesemia can occur from absorption of fluoride ion into blood stream. Symptoms may be delayed.

Carcinogenicity
This product is not considered to be a carcinogen by IARC, ACGIH, NTP, or OSHA.

ACGIH Carcinogens
AMMONIUM FLUORIDE (CAS 12125-01-8) A4 Not classifiable as a human carcinogen.
HYDROFLUORIC ACID (CAS 7664-39-3) A4 Not classifiable as a human carcinogen.

IARC Monographs. Overall Evaluation of Carcinogenicity
AMMONIUM FLUORIDE (CAS 12125-01-8) 3 Not classifiable as to carcinogenicity to humans.
HYDROFLUORIC ACID (CAS 7664-39-3) 3 Not classifiable as to carcinogenicity to humans.

Skin corrosion/irritation
Corrosive to skin and eyes. The fluoride ion readily penetrates the skin causing destruction of deep tissue layers and even bone. Symptoms may develop after several hours.

Epidemiology
No epidemiological data is available for this product.

Mutagenicity
No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.

Neurological effects
No data available for this product.

Reproductive effects
Contains no ingredient listed as toxic to reproduction

Teratogenicity
No data available for this product.

Symptoms and target organs

Further information
Danger of very serious irreversible effects. Symptoms may be delayed.

12. Ecological Information

Ecotoxicity
The product may affect the acidity (pH-factor) in water with risk of harmful effects to aquatic organisms.

Environmental effects
An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Persistence and degradability
Expected to be readily biodegradable.

Partition coefficient (n-octanol/water)
Not available

13. Disposal Considerations

Waste codes
US RCRA Hazardous Waste U List: Reference
HYDROFLUORIC ACID (CAS 7664-39-3) U134

Disposal instructions
Dispose of this material and its container to hazardous or special waste collection point. Incinerate the material under controlled conditions in an approved incinerator. All wastes must be handled in accordance with local, state and federal regulations.

Contaminated packaging
Since emptied containers retain product residue, follow label warnings even after container is emptied. Offer rinsed packaging material to local recycling facilities.

14. Transport Information

DOT
Basic shipping requirements:
UN number UN2922
Proper shipping name Corrosive liquid, toxic, n.o.s. (HYDROFLUORIC ACID, AMMONIUM FLUORIDE)
Hazard class 8
Subsidiary hazard class 6.1
Packing group II
Additional information:

Special provisions: B3, IB2, T7, TP2

Basic shipping requirements:

Labels required: 8, 6.1

Additional information:

Packaging exceptions: 154
Packaging non bulk: 202
Packaging bulk: 243
ERG number: 154

Notes
Depending on the quantity of material shipped, this product may be subject to the Hazardous Substances (RQ) requirements illustrated in the 49 CFR 172.101 Appendix A.

IATA

Basic shipping requirements:

UN number: 2922
Proper shipping name: Corrosive liquid, toxic, n.o.s. (HYDROFLUORIC ACID, AMMONIUM FLUORIDE)
Hazard class: 8
Subsidiary hazard class: 6.1
Packing group: II

IMDG

Basic shipping requirements:

UN number: 2922
Proper shipping name: CORROSIVE LIQUID, TOXIC, N.O.S. (HYDROFLUORIC ACID, AMMONIUM FLUORIDE)
Hazard class: 8
Subsidiary hazard class: 6.1
Packing group: II

15. Regulatory Information

US federal regulations
This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.
All components are on the U.S. EPA TSCA Inventory List.

US EPCRA (SARA Title III) Section 302 - Extremely Hazardous Spill: Reportable quantity
HYDROFLUORIC ACID (CAS 7664-39-3) 100 LBS

US EPCRA (SARA Title III) Section 302 - Extremely Hazardous Substance: Threshold Planning Quantity
HYDROFLUORIC ACID (CAS 7664-39-3) 100 LBS

US EPCRA (SARA Title III) Section 313 - Toxic Chemical: De minimis concentration
AMMONIUM FLUORIDE (CAS 12125-01-8) 1.0 %
HYDROFLUORIC ACID (CAS 7664-39-3) 1.0 %

US EPCRA (SARA Title III) Section 313 - Toxic Chemical: Listed substance
AMMONIUM FLUORIDE (CAS 12125-01-8) Listed.
HYDROFLUORIC ACID (CAS 7664-39-3) Listed.
CERCLA (Superfund) reportable quantity

AMMONIUM FLUORIDE: 100.0000
HYDROFLUORIC ACID: 100.0000

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories
Immediate Hazard - Yes
Delayed Hazard - Yes
Fire Hazard - No
Pressure Hazard - No
Reactivity Hazard - No

Section 311 hazardous chemical
Yes

Inventory status

<table>
<thead>
<tr>
<th>Country(s) or region</th>
<th>Inventory name</th>
<th>On inventory (yes/no)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>Australian Inventory of Chemical Substances (AICS)</td>
<td>Yes</td>
</tr>
<tr>
<td>Canada</td>
<td>Domestic Substances List (DSL)</td>
<td>Yes</td>
</tr>
<tr>
<td>Canada</td>
<td>Non-Domestic Substances List (NDSL)</td>
<td>No</td>
</tr>
<tr>
<td>China</td>
<td>Inventory of Existing Chemical Substances in China (IECSC)</td>
<td>Yes</td>
</tr>
<tr>
<td>Europe</td>
<td>European Inventory of Existing Commercial Chemical Substances (EINECS)</td>
<td>Yes</td>
</tr>
<tr>
<td>Europe</td>
<td>European List of Notified Chemical Substances (ELINCS)</td>
<td>No</td>
</tr>
<tr>
<td>Japan</td>
<td>Inventory of Existing and New Chemical Substances (ENCS)</td>
<td>Yes</td>
</tr>
<tr>
<td>Korea</td>
<td>Existing Chemicals List (ECL)</td>
<td>Yes</td>
</tr>
<tr>
<td>New Zealand</td>
<td>New Zealand Inventory</td>
<td>Yes</td>
</tr>
<tr>
<td>Philippines</td>
<td>Philippine Inventory of Chemicals and Chemical Substances (PICCS)</td>
<td>Yes</td>
</tr>
<tr>
<td>United States &amp; Puerto Rico</td>
<td>Toxic Substances Control Act (TSCA) Inventory</td>
<td>Yes</td>
</tr>
</tbody>
</table>

* "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)

State regulations
This product does not contain a chemical known to the State of California to cause cancer, birth defects or other reproductive harm.

US - New Jersey Community RTK (EHS Survey): Reportable threshold
HYDROFLUORIC ACID (CAS 7664-39-3) 100 LBS
HYDROFLUORIC ACID (CAS 7664-39-3) 500 LBS

US - Pennsylvania RTK - Hazardous Substances: Listed substance
AMMONIUM FLUORIDE (CAS 12125-01-8) Listed.
HYDROFLUORIC ACID (CAS 7664-39-3) Listed.

Saf-T-Data
Health: 4 - Extreme (Poison)
Flammability: 0 - None
Reactivity: 2 - Moderate
Contact: 4 - Extreme (Corrosive)
Lab Protective Equip: D - GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: W - White (Corrosive)

16. Labeling Info

Label Hazard Warning
DANGER

Corrosive. Causes severe skin and eye burns. Causes digestive tract burns. May be fatal if inhaled, absorbed through skin, or swallowed. Mist or vapor extremely irritating to eyes and respiratory tract. Causes blood, cardiovascular system and respiratory system damage. Prolonged exposure may cause chronic effects. Material reacts with water.

Label Precautions
Do not breathe mist or vapor. Do not get in eyes, on skin, or on clothing. Do not ingest. Use only with adequate ventilation. Wash thoroughly after handling. Container must be kept tightly closed.
Label First Aid

Immediately flush eyes with plenty of water for at least 15 minutes. Immediately flush skin with plenty of water. If gas/fume/vapor/dust/mist from the material is inhaled, remove the affected person immediately to fresh air. Oxygen or artificial respiration if needed. Call a physician or poison control center immediately. IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician. Do not induce vomiting without advice from poison control center. If vomiting occurs, keep head low so that stomach content doesn't get into the lungs.

17. Other Information

NFPA ratings

Health: 4  
Flammability: 0  
Instability: 1

Disclaimer

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Issue date

08-26-2011