SAFETY DATA SHEET

1. Identification

Product identifier: Ferrous Chloride Solution

Other means of identification

SDS number: WS012

Recommended use: Acid Recovery.

Recommended restrictions: None known.

Manufacturer/Importer/Supplier/Distributor information

Manufacturer/Supplier: The Worthington Steel Company
Address: 200 Old Wilson Bridge Road
Columbus, OH 43085
United States

Email: steel@worthingtonindustries.com
Telephone Number: 800-944-3733
CHEMTREC - 24 HOURS: Within US: 800-424-9300 International: +1 703-741-5970 (collect calls accepted)

2. Hazard(s) identification

Physical hazards: Corrosive to metals Category 1

Health hazards: Acute toxicity, oral Category 4
Skin corrosion/irritation Category 1B
Serious eye damage/eye irritation Category 1
Specific target organ toxicity, single exposure Category 3 respiratory tract irritation
Specific target organ toxicity, repeated exposure Category 2 (liver)

Environmental hazards: Hazardous to the aquatic environment, acute hazard Category 2

OSHA defined hazards: Not classified.

Label elements

Signal word: Danger

Hazard statement: May be corrosive to metals. Causes severe skin burns and eye damage. May cause respiratory irritation. May cause damage to organs (liver) through prolonged or repeated exposure. Toxic to aquatic life.

Precautionary statement

Prevention: Wash thoroughly after handling. Do not eat, drink or smoke when using this product. Do not breathe mist or vapor. Wear protective gloves/protective clothing/eye protection/face protection. Use only outdoors or in a well-ventilated area. Keep only in original container. Avoid release to the environment.

Response: Immediately call a poison center/doctor. If swallowed: Rinse mouth. Do NOT induce vomiting. If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower. Wash contaminated clothing before reuse. If inhaled: Remove person to fresh air and keep comfortable for breathing. If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Absorb spillage to prevent material damage.

Storage: Store in a well-ventilated place. Keep container tightly closed. Store in corrosive resistant container with a resistant inner liner. Store locked up.

Disposal: Dispose of contents/container in accordance with local/regional/national/international regulations.
3. Composition/information on ingredients

Mixtures

<table>
<thead>
<tr>
<th>Chemical name</th>
<th>CAS number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>7732-18-5</td>
<td>65-75</td>
</tr>
<tr>
<td>Ferrous chloride</td>
<td>7758-94-3</td>
<td>20-30</td>
</tr>
<tr>
<td>Hydrochloric acid</td>
<td>7647-01-0</td>
<td>2-8</td>
</tr>
</tbody>
</table>

Composition comments

All concentrations are in percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

4. First-aid measures

Inhalation

Move to fresh air. If breathing is difficult, give oxygen. Get medical attention immediately. Do not use mouth-to-mouth method if victim inhaled the substance. Induce artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device.

Skin contact

Remove and isolate contaminated clothing and shoes. Immediately flush with plenty of water for at least 15 minutes. Get medical attention immediately. Wash clothing separately before reuse.

Eye contact

Immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical attention immediately.

Ingestion

Corrosive effects. Symptoms include itching, burning, redness, and tearing of eyes.

Most important symptoms/effects, acute and delayed

Treat symptomatically.

Indication of immediate medical attention and special treatment needed

Show this safety data sheet to the doctor in attendance.

5. Fire-fighting measures

Suitable extinguishing media

Dry chemical, foam, carbon dioxide.

Unsuitable extinguishing media

None.

Specific hazards arising from the chemical

Fire may produce irritating, corrosive and/or toxic gases.

Special protective equipment and precautions for firefighters

Firefighters should wear full protective clothing including self contained breathing apparatus.

Firefighting equipment/instructions

Move containers from fire area if you can do it without risk.

Specific methods

Use standard firefighting procedures and consider the hazards of other involved materials.

General fire hazards

During fire, gases hazardous to health may be formed.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

Keep unnecessary personnel away. Wear appropriate protective equipment and clothing during clean-up. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Avoid inhalation of vapors and contact with skin and eyes. Local authorities should be advised if significant spills cannot be contained.

Methods and materials for containment and cleaning up

Stop the flow of material, if this is without risk. Dike far ahead of spill for later disposal. Neutralize with soda ash or sodium bicarbonate. For waste disposal, see Section 13 of the SDS.

Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not contaminate water.

7. Handling and storage

Precautions for safe handling

Wear appropriate personal protective equipment (See Section 8). Use only with adequate ventilation. Do not breathe fumes. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling. Observe good industrial hygiene practices.

Conditions for safe storage, including any incompatibilities

Store only in original container. Store in corrosive resistant container with a resistant inner liner. Store away from incompatible materials.
8. Exposure controls/personal protection

Occupational exposure limits

US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

<table>
<thead>
<tr>
<th>Components</th>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrochloric acid (CAS 7647-01-0)</td>
<td>Ceiling</td>
<td>7 mg/m³</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 ppm</td>
</tr>
</tbody>
</table>

US. ACGIH Threshold Limit Values

<table>
<thead>
<tr>
<th>Components</th>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ferrous chloride (CAS 7758-94-3)</td>
<td>TWA</td>
<td>1 mg/m³</td>
</tr>
<tr>
<td>Hydrochloric acid (CAS 7647-01-0)</td>
<td>Ceiling</td>
<td>2 ppm</td>
</tr>
</tbody>
</table>

US. NIOSH: Pocket Guide to Chemical Hazards

<table>
<thead>
<tr>
<th>Components</th>
<th>Type</th>
<th>Value</th>
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</thead>
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<td>7 mg/m³</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 ppm</td>
</tr>
</tbody>
</table>

No biological exposure limits noted for the ingredient(s).

Biological limit values

Use personal protective equipment as required. Keep working clothes separately.

Exposure guidelines

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. An eye wash and safety shower must be available in the immediate work area.

Individual protection measures, such as personal protective equipment

Eye/face protection

Wear approved safety glasses or goggles.

Skin protection

Hand protection

Wear protective gloves.

Other

Wear suitable protective equipment.

Respiratory protection

Use a respirator when local exhaust or ventilation is not adequate to keep exposures below the OEL. In a confined space a supplied respirator may be required. Selection and use of respiratory protective equipment should be in accordance with OSHA General Industry Standard 29 CFR 1910.134; or in Canada with CSA Standard Z94.4.

Thermal hazards

Wear appropriate thermal protective clothing, when necessary.

General hygiene considerations

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.

9. Physical and chemical properties

Appearance

Physical state | Liquid.
Form | Liquid.
Color | Green to brown.
Odor | Slightly acrid.
Odor threshold | Not available.
pH | < 1
Melting point/freezing point | Not available.
Initial boiling point and boiling range | 200 - 225 °F (93.33 - 107.22 °C)
Flash point | Not applicable.
Evaporation rate | 0.6 (Butyl acetate = 1)
Flammability (solid, gas)  Non flammable.

Upper/lower flammability or explosive limits
  Flammability limit - lower (%)
  Not applicable.
  Flammability limit - upper (%)
  Not applicable.

Vapor pressure  40 mm Hg (35°C/95°F)
Vapor density  Not available.
Relative density  1.2 - 1.4 (Water = 1)
Solubility(ies)
  Solubility (water)  Very Soluble.
Partition coefficient (n-octanol/water)  Not available.
Auto-ignition temperature  Not applicable.
Decomposition temperature  Not available.
Viscosity  Not available.
Other information
  Percent volatile  65 - 75 % Water

10. Stability and reactivity
Reactivity  The product is non-reactive under normal conditions of use, storage and transport.
Chemical stability  Material is stable under normal conditions.
Possibility of hazardous reactions  Hazardous polymerization does not occur.
Conditions to avoid  Contact with metals. Excessive heat or cold.
Incompatible materials  Alkalines. Strong oxidizing agents.
Hazardous decomposition products  Thermal decomposition or combustion may liberate corrosive gases or fumes. Hydrogen chloride gas. Chlorine. Ferric oxide and ferrous oxide fumes.

11. Toxicological information
Information on likely routes of exposure
  Inhalation  Corrosive to the respiratory tract.
  Skin contact  Causes skin burns.
  Eye contact  Causes serious eye damage.
  Ingestion  Harmful if swallowed. Ingestion may produce burns to the lips, oral cavity, upper airway, esophagus and possibly the digestive tract.

Symptoms related to the physical, chemical and toxicological characteristics  Corrosive effects. Symptoms include itching, burning, redness, and tearing of eyes.

Information on toxicological effects
Acute toxicity  Causes burns. Harmful if swallowed.

<table>
<thead>
<tr>
<th>Components</th>
<th>Species</th>
<th>Test Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ferrous chloride (CAS 7758-94-3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acute</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oral</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LD50</td>
<td>Rat</td>
<td>450 mg/kg</td>
</tr>
<tr>
<td>Hydrochloric acid (CAS 7647-01-0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acute</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inhalation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LC50</td>
<td>Rat</td>
<td>3124 ppm, 1 Hours</td>
</tr>
</tbody>
</table>

Skin corrosion/irritation  Causes skin burns.
Serious eye damage/eye irritation  Causes serious eye damage.
Respiratory or skin sensitization

Respiratory sensitization
Not classified.

Skin sensitization
Not classified.

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

Carcinogenicity
This product is not considered to be a carcinogen by IARC, ACGIH, NTP, or OSHA. Dissolved metals may be present that are suspected or confirmed human carcinogens (e.g. chromium, nickel)

IARC Monographs. Overall Evaluation of Carcinogenicity
Hydrochloric acid (CAS 7647-01-0) 3 Not classifiable as to carcinogenicity to humans.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)
Not listed.

Reproductive toxicity
Not classified.

Specific target organ toxicity - single exposure
May cause respiratory tract irritation.

Specific target organ toxicity - repeated exposure
May cause damage to organs (liver) through prolonged or repeated exposure.

Aspiration hazard
Not classified.

Chronic effects
Can cause delayed lung injury.

Further information
No other specific acute or chronic health impact noted.

12. Ecological information

Ecotoxicity
Toxic to aquatic life.

<table>
<thead>
<tr>
<th>Components</th>
<th>Species</th>
<th>Test Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ferrous chloride (CAS 7758-94-3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Aquatic</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fish</td>
<td>LC50</td>
<td>Striped bass (Morone saxatilis) 4 mg/l, 96 Hours</td>
</tr>
</tbody>
</table>

Persistence and degradability
No data is available on the degradability of this product.

Bioaccumulative potential
No data available.

Mobility in soil
This product is water soluble and may disperse in soil.

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

13. Disposal considerations

Disposal instructions
Dispose waste and residues in accordance with applicable federal, state, and local regulations.

Hazardous waste code
D002: Waste Corrosive material [pH <=2 or =>12.5, or corrosive to steel]

Waste from residues / unused products
Dispose in accordance with all applicable regulations.

Contaminated packaging
Empty containers should be taken to an approved waste handling site for recycling or disposal.

14. Transport information

DOT
UN number
UN1760
UN proper shipping name
Corrosive liquids, n.o.s. (Ferrous chloride RQ = 400 LBS, Hydrochloric acid RQ = 100000 LBS)
Transport hazard class(es)
Class 8
Subsidiary risk -
Label(s) 8
Packing group II
Environmental hazards
Marine pollutant No
Special precautions for user
Read safety instructions, SDS and emergency procedures before handling.
Special provisions
B2, IB2, T11, TP2, TP27
Packaging exceptions 154
Packaging non bulk 202
Packaging bulk 242
IATA
UN number UN1760
UN proper shipping name Corrosive liquid, n.o.s. (Ferrous chloride, Hydrochloric acid)
Transport hazard class(es)
  Class 8
  Subsidiary risk -
  Label(s) 8
Packing group II
Environmental hazards No
ERG Code 8L
Special precautions for user Read safety instructions, SDS and emergency procedures before handling.

IMDG
UN number UN1760
UN proper shipping name CORROSIVE LIQUID, N.O.S. (Ferrous chloride, Hydrochloric acid)
Transport hazard class(es)
  Class 8
  Subsidiary risk -
  Label(s) 8
Packing group II
Environmental hazards
  Marine pollutant No
EmS F-A, S-B
Special precautions for user Read safety instructions, SDS and emergency procedures before handling.
Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

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.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)
Not regulated.
OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)
Not listed.
CERCLA Hazardous Substance List (40 CFR 302.4)
  Ferrous chloride (CAS 7758-94-3) LISTED
  Hydrochloric acid (CAS 7647-01-0) LISTED

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

SARA 302 Extremely hazardous substance

<table>
<thead>
<tr>
<th>Chemical name</th>
<th>CAS number</th>
<th>Reportable quantity (pounds)</th>
<th>Threshold planning quantity (pounds)</th>
<th>Threshold planning quantity, lower value (pounds)</th>
<th>Threshold planning quantity, upper value (pounds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrochloric acid</td>
<td>7647-01-0</td>
<td>5000</td>
<td>500</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SARA 311/312 Hazardous chemical

SARA 313 (TRI reporting)

<table>
<thead>
<tr>
<th>Chemical name</th>
<th>CAS number</th>
<th>% by wt.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrochloric acid</td>
<td>7647-01-0</td>
<td>2-8</td>
</tr>
</tbody>
</table>
Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List
Hydrochloric acid (CAS 7647-01-0)

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)
Hydrochloric acid (CAS 7647-01-0)

Safe Drinking Water Act (SDWA)
Drug Enforcement Administration (DEA). List 2, Essential Chemicals (21 CFR 1310.02(b) and 1310.04(f)(2) and Chemical Code Number
Hydrochloric acid (CAS 7647-01-0) 6545

Drug Enforcement Administration (DEA). List 1 & 2 Exempt Chemical Mixtures (21 CFR 1310.12(c))
Hydrochloric acid (CAS 7647-01-0) 20 %WV

DEA Exempt Chemical Mixtures Code Number
Hydrochloric acid (CAS 7647-01-0) 6545

Not regulated.

Safe Drinking Water Act

Drug Enforcement Administration (DEA). List 2, Essential Chemicals (21 CFR 1310.02(b) and 1310.04(f)(2) and Chemical Code Number
Hydrochloric acid (CAS 7647-01-0) 6545

Drug Enforcement Administration (DEA). List 1 & 2 Exempt Chemical Mixtures (21 CFR 1310.12(c))
Hydrochloric acid (CAS 7647-01-0) 20 %WV

DEA Exempt Chemical Mixtures Code Number
Hydrochloric acid (CAS 7647-01-0) 6545

US 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. Massachusetts RTK - Substance List
Ferrous chloride (CAS 7758-94-3)
Hydrochloric acid (CAS 7647-01-0)

US. New Jersey Worker and Community Right-to-Know Act
Ferrous chloride (CAS 7758-94-3)
Hydrochloric acid (CAS 7647-01-0)

US. Pennsylvania Worker and Community Right-to-Know Law
Ferrous chloride (CAS 7758-94-3)
Hydrochloric acid (CAS 7647-01-0)

US. Rhode Island RTK
Hydrochloric acid (CAS 7647-01-0)

US. California Proposition 65
Not Listed.

International Inventories

<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>

*A "Yes" indicates this product complies with the inventory requirements administered by the governing country(s).
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other information, including date of preparation or last revision

Issue date: 01-June-2015
Revision date: -
Version #: 01

Further information: HMIS® is a registered trade and service mark of the NPCA.

HMIS® ratings
- Health: 3*
- Flammability: 0
- Physical hazard: 0
NFPA ratings

Disclaimer

All information in this Material Safety Data Sheet is believed to be accurate and reliable. However, no guarantee or warranty of any kind is made with regard to the accuracy of information or the suitability of the recommendations contained herein. It is the user's responsibility to assess the safety and toxicity of this product under their own conditions of use and to comply with all applicable laws and regulations.