1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product code: T2798
Product Name: TRIS(2,2'-BIPYRIDYL)DICHLORORUTHENIUM(II), HEXAHYDRATE
Chemical Name: Ruthenium(2+), tris(2,2'-bipyridine-N,N')-, dichloride, hexahydrate, (OC-6-11)-
Synonyms:
- Ruthenium-tris(2,2'-bipyridyl) Dichloride Hexahydrate
- Tris(2,2'-bipridyl)ruthenium(II) chloride Hexahydrate
- Tris(bipyridine)ruthenium(II) chloride hexahydrate
- Tris(2,2'-bipyridine)ruthenium dichloride hexahydrate

Recommended use: No information available.
CAS #: 50525-27-4
Formula: C30-H24-Cl2-N6-Ru.6H2O
RTECS #: VM2730000
C#: Not available
Supplier: Spectrum Chemicals and Laboratory Products, Inc.
14422 South San Pedro St.
Gardena, CA 90248
(310) 516-8000
Emergency Telephone Number: CHEMTREC: 1-800-424-9300
Contact Person: Martin LaBenz (West Coast)
Contact Person: Chris Terpak (East Coast)

2. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW
May cause skin and eye irritation. May cause irritation of respiratory tract.

Odor: No information available
Physical state: Solid
Appearance: Powder
Color: Dark red

OSHA Regulatory Status: This material is not considered hazardous by the OSHA Hazard Communication Standard (29 1910.1200)
2. HAZARDS IDENTIFICATION

POTENTIAL HEALTH EFFECTS

Principal Routes of Exposure:
Ingestion. Inhalation.

Acute Potential Health Effects:

Skin Contact:
May cause skin irritation.

Eye Contact:
May cause eye irritation.

Inhalation:
May cause irritation of respiratory tract.

Ingestion:
No information available. Expected to be a low hazard.

Chronic Potential Health Effects:

<table>
<thead>
<tr>
<th>Component</th>
<th>Carcinogen Status:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tris(2,2'-bipyridyl)dichlororuthenium(II), Hexahydrate 50525-27-4 (100)</td>
<td>No information available</td>
</tr>
</tbody>
</table>

Target Organs: No information available

Teratogenic Effects: No information available

Mutagenic Effects: No information available

Aggravated Medical Conditions: No information available

See Section 11 for additional Toxicological Information

POTENTIAL ENVIRONMENTAL EFFECTS

No information available

3. COMPOSITION/INFORMATION ON INGREDIENTS

<table>
<thead>
<tr>
<th>Components</th>
<th>CAS-No.</th>
<th>Weight %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tris(2,2'-bipyridyl)dichlororuthenium(II), Hexahydrate 50525-27-4 (100)</td>
<td>50525-27-4</td>
<td>100</td>
</tr>
</tbody>
</table>

4. FIRST AID MEASURES

General Advice: Poison information centres in each State capital city can provide additional assistance for scheduled poisons (13 1126)
Skin Contact: Wash off immediately with soap and plenty of water removing all contaminated clothes and shoes. Get medical attention if irritation develops.

Eye Contact: Flush eye with water for 15 minutes. Get medical attention if irritation occurs. If symptoms persist, call a physician.

Inhalation: Move to fresh air. If breathing is difficult, give oxygen. In case of shortness of breath, give oxygen. Get medical attention.

Ingestion: Do not induce vomiting without medical advice. Never give anything by mouth to an unconscious person. Consult a physician if necessary.

Notes to Physician: Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Flammable Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flashpoint (°C/°F)</td>
<td>No information available.</td>
</tr>
<tr>
<td>Tested according to:</td>
<td>Not available</td>
</tr>
<tr>
<td>Lower Explosion Limit (%)</td>
<td>No information available</td>
</tr>
<tr>
<td>Upper Explosion Limit (%)</td>
<td>No information available</td>
</tr>
<tr>
<td>Autoignition Temperature (°C/°F)</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

Suitable Extinguishing Media: Carbon dioxide (CO2), Dry chemical. Water spray mist or foam.

Unsuitable Extinguishing Media: No information available.

Hazardous Combustion Products: Carbon monoxide; Carbon dioxide; Nitrogen oxides; Hydrogen Chloride gas; Ruthenium oxide

Specific hazards: May be combustible at high temperatures.

Special Protective Equipment for Firefighters: As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear

Specific Methods: No information available.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions: Ensure adequate ventilation. Use personal protective equipment. Avoid contact with skin, eyes and clothing. Avoid dust formation. Remove all sources of ignition.

Environmental Precautions: No information available.

Methods for Cleaning Up: Sweep up and shovel into suitable containers for disposal. Avoid dust formation. Clean contaminated surface thoroughly.
7. HANDLING AND STORAGE

Handling

Technical Measures/Precautions:
Provide sufficient air exchange and/or exhaust in work rooms. Avoid dust formation. All equipment used when handling the product must be grounded. Keep away from incompatible materials.

Safe Handling Advice:
Wear personal protective equipment. Avoid contact with skin, eyes and clothing. Avoid dust formation. Do not ingest. Do not breathe vapours/dust. Keep away from heat and sources of ignition. Handle in accordance with good industrial hygiene and safety practice.

Storage

Technical Measures/Storage Conditions:

Incompatible Products:
Oxidizing agents.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering measures to reduce exposure:
Ensure adequate ventilation. Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protective Equipment

Eye protection: Safety glasses. Safety glasses with side-shields.
Skin and body protection: Long sleeved clothing. Chemical resistant apron. Gloves.
Respiratory protection: Wear respirator with dust filter..
Hygiene measures: Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product. When using, do not eat, drink or smoke.

National occupational exposure limits

United States
U.S Occupational Exposure Limits: Not determined

<table>
<thead>
<tr>
<th>Components</th>
<th>OSHA</th>
<th>NIOSH</th>
<th>ACGIH</th>
<th>AIHA WHEEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tris(2,2'-bipyridyl)dichlororuthenium(II), Hexahydrate - 50525-27-4</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Canada
Canada Occupational Exposure Limits: Not determined

Product code: T2798
Product name: TRIS(2,2'-BIPYRIDYL)DICHLORORUTHENIUM(II), HEXAHYDRATE
Australia and Mexico

Occupational Exposure Limits for Australia and Mexico: Not determined

### 9. PHYSICAL AND CHEMICAL PROPERTIES

<table>
<thead>
<tr>
<th>Physical state:</th>
<th>Appearance:</th>
<th>Color:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Odor:</td>
<td>Taste</td>
<td>Molecular/Formula weight:</td>
</tr>
<tr>
<td>No information available</td>
<td>No information available</td>
<td>748.63</td>
</tr>
<tr>
<td>Flash point (°C):</td>
<td>Lower Explosion Limit (%):</td>
<td>Upper Explosion Limit (%):</td>
</tr>
<tr>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Autoignition Temperature (°C/°F):</td>
<td>pH:</td>
<td>Melting point/range(°C/°F):</td>
</tr>
<tr>
<td>No information available</td>
<td>No information available</td>
<td>&gt;300 °C/&gt;572 °F</td>
</tr>
<tr>
<td>Boiling point/range(°C/°F):</td>
<td>Decomposition temperature(°C/°F):</td>
<td>Specific gravity:</td>
</tr>
<tr>
<td>No information available</td>
<td>No information available</td>
<td>No information available</td>
</tr>
<tr>
<td>Density (g/cm³):</td>
<td>Bulk density:</td>
<td>Vapor pressure @ 20°C (kPa):</td>
</tr>
<tr>
<td>No information available</td>
<td>No information available</td>
<td>No information available</td>
</tr>
<tr>
<td>Evaporation rate:</td>
<td>Vapor density:</td>
<td>VOC content (g/L):</td>
</tr>
<tr>
<td>No information available</td>
<td>No information available</td>
<td>No information available</td>
</tr>
<tr>
<td>Odor threshold (ppm):</td>
<td>Partition coefficient (n-octanol/water):</td>
<td>Miscibility:</td>
</tr>
<tr>
<td>No information available</td>
<td>No information available</td>
<td>No information available</td>
</tr>
</tbody>
</table>

Solubility: No information available

### 10. STABILITY AND REACTIVITY

Stability: Stable at normal conditions

Conditions to avoid: Heat. Avoid dust formation. Dust may form explosive mixture in air. Fine dust dispersed in air in sufficient concentrations, and in the presence of an ignition source is a potential dust explosion hazard. Incompatible materials.

Materials to avoid: Strong oxidising agents.


Possibility of Hazardous Reactions: No information available
11. TOXICOLOGICAL INFORMATION

Acute Toxicity

Component Information

*Tris(2,2'-bipyridyl)dichlororuthenium(II), Hexahydrate - 50525-27-4*

<table>
<thead>
<tr>
<th>Toxicity</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LD50/oral/rat</td>
<td>No information available</td>
</tr>
<tr>
<td>LD50/oral/mouse</td>
<td>No information available</td>
</tr>
<tr>
<td>LD50/dermal/rabbit</td>
<td>No information available</td>
</tr>
<tr>
<td>LD50/dermal/rat</td>
<td>No information available</td>
</tr>
<tr>
<td>LC50/inhalation/rat</td>
<td>No information available</td>
</tr>
<tr>
<td>LC50/inhalation/mouse</td>
<td>No information available</td>
</tr>
<tr>
<td>Other LD50 or LC50 information</td>
<td>No information available</td>
</tr>
</tbody>
</table>

Product Information

<table>
<thead>
<tr>
<th>Toxicity</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC50/inhalation/rat</td>
<td>No information available</td>
</tr>
<tr>
<td>LC50/inhalation/mouse</td>
<td>No information available</td>
</tr>
<tr>
<td>LD50/dermal/rabbit</td>
<td>No information available</td>
</tr>
<tr>
<td>LD50/dermal/rat</td>
<td>No information available</td>
</tr>
<tr>
<td>LD50/oral/mouse</td>
<td>No information available</td>
</tr>
<tr>
<td>LD50/oral/rat</td>
<td>No information available</td>
</tr>
</tbody>
</table>

Local Effects

<table>
<thead>
<tr>
<th>Effect</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skin irritation</td>
<td>May cause skin irritation.</td>
</tr>
<tr>
<td>Eye irritation</td>
<td>Contact with eyes may cause irritation.</td>
</tr>
<tr>
<td>Inhalation</td>
<td>May cause irritation of respiratory tract.</td>
</tr>
<tr>
<td>Ingestion</td>
<td>Health injuries are not known or expected under normal use.</td>
</tr>
<tr>
<td>Sensitization</td>
<td>No information available</td>
</tr>
</tbody>
</table>

Chronic Toxicity

<table>
<thead>
<tr>
<th>Toxicity</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic Toxicity</td>
<td>No information available</td>
</tr>
<tr>
<td>Carcinogenic effects</td>
<td>Not considered carcinogenic</td>
</tr>
</tbody>
</table>

Product code: T2798

Product name: TRIS(2,2'-BIPYRIDYL)DICHLORORUTHENIUM(II), HEXAHYDRATE
Components | NTP | IARC | OSHA HCS - Carcinogens | ACGIH - Carcinogens | Australia - Prohibited Carcinogenic Substances | Australia - Notifiable Carcinogenic Substances
--- | --- | --- | --- | --- | --- | ---
Tris(2,2'-bipyridyl)dichlororuthenium(II), Hexahydrate | Not listed | Not listed | Not listed | Not listed | Not listed | Not listed

Mutagenic Effects: No information available
Reproductive Effects: No information available
Teratogenic Effects: No information available
Target Organs: No information available

12. ECOLOGICAL INFORMATION

ECOTOXICITY
Toxicity to terrestrial and aquatic plants and animals: No information available
Ecotoxicity effects: No data available.
Aquatic toxicity: No information available
Mobility: No information available
Persistence and degradability: No information available
Bioaccumulative potential: No information available

13. DISPOSAL CONSIDERATIONS

Waste from residues / unused products:
Waste must be disposed of in accordance with Federal, State and Local regulation.

Contaminated packaging:
Empty containers should be taken for local recycling, recovery or waste disposal

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tris(2,2'-bipyridyl)dichlororuthenium(II), Hexahydrate</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

14. TRANSPORT INFORMATION

DOT
UN-No: Not regulated
Proper Shipping Name: No information available
Hazard Class: No information available
Packing Group: None
Subsidiary Risk: Not applicable
Marine Pollutant: No data available
ERG No: No information available
DOT RQ (lbs): No information available

Product code: T2798
Product name: TRIS(2,2'-BIPYRIDYL)DICHLORORUTHENIUM(II), HEXAHYDRATE
TDG (Canada)
UN-No: Not Regulated
Proper Shipping Name: No information available
Hazard Class: No information available
Packing Group: No information available
Subsidiary Risk: No information available
Description: No information available

ADR
UN-No: Not Regulated
Proper Shipping Name: No information available
Hazard Class: No information available
Packing Group: No information available
Subsidiary Risk: No information available
Classification Code: No information available
Description: No information available
CEFIC Tremcard No: No information available

IMO / IMDG
UN-No: Not Regulated
Proper Shipping Name: No information available
Hazard Class: No information available
Packing Group: No information available
Subsidiary Risk: No information available
Classification Code: No information available
Description: No information available
IMDG Page: No information available
Marine Pollutant: No information available
MFAG: No information available
Maximum Quantity: No information available

RID
UN-No: Not Regulated
Proper Shipping Name: No information available
Hazard Class: No information available
Packing Group: No information available
Subsidiary Risk: No information available
Classification Code: No information available
Description: No information available

ICAO
UN-No: Not Regulated
Proper Shipping Name: No information available
Hazard Class: No information available
Packing Group: No information available
Subsidiary Risk: No information available
Description: No information available

IATA
UN-No: Not Regulated
Proper Shipping Name: No information available
Hazard Class: No information available
Packing Group: No information available
Subsidiary Risk: No information available
Description: No information available

15. REGULATORY INFORMATION

Product code: T2798
Product name: TRIS(2,2-BIPYRIDYL)DICHLORORUTHENIUM(II), HEXAHYDRATE
International Inventories

<table>
<thead>
<tr>
<th>Components</th>
<th>U.S. TSCA</th>
<th>Philippines (PICCS)</th>
<th>KOREA KECL</th>
<th>Japan ENCS</th>
<th>CHINA</th>
<th>Australia (AICS)</th>
<th>EINECS-No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tris(2,2'-bipyridyl)dichlororuthenium(II), Hexahydrate</td>
<td>Not Listed</td>
<td>Not present</td>
<td>Not present</td>
<td>Not present</td>
<td>Not present</td>
<td>Not present</td>
<td>Not present</td>
</tr>
</tbody>
</table>

U.S. Regulations


Chemicals Known to the State of California to Cause Cancer:
This product does not contain a chemical requiring a warning under California Prop. 65. (See table below)

Chemicals Known to the State of California to Cause Reproductive Toxicity:
This product does not contain a chemical requiring a warning under California Prop. 65. (See table below)

<table>
<thead>
<tr>
<th>Components</th>
<th>Carcinogen</th>
<th>Developmental Toxicity</th>
<th>Male Reproductive Toxicity</th>
<th>Female Reproductive Toxicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tris(2,2'-bipyridyl)dichlororuthenium(II), Hexahydrate</td>
<td>Not Listed</td>
<td>Not Listed</td>
<td>Not Listed</td>
<td>Not Listed</td>
</tr>
</tbody>
</table>

CERCLA/SARA

<table>
<thead>
<tr>
<th>Components</th>
<th>CERCLA - Hazardous Substances and their Reportable Quantities</th>
<th>Section 302 Extremely Hazardous Substances and TPQs</th>
<th>Section 302 Extremely Hazardous Substances and RQs</th>
<th>Section 313 - Chemical Category</th>
<th>Section 313 - Reporting de minimis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tris(2,2'-bipyridyl)dichlororuthenium(II), Hexahydrate</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

U.S. TSCA

<table>
<thead>
<tr>
<th>Components</th>
<th>TSCA Section 5(a)2 - Chemicals With Significant New Use Rules (SNURS)</th>
<th>TSCA 8(d) - Health and Safety Reporting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tris(2,2'-bipyridyl)dichlororuthenium(II), Hexahydrate</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
</tr>
</tbody>
</table>

Canada

WHMIS hazard class:
Non-controlled

Canada Controlled Products Regulation:
This product has been classified according to the hazard criteria of the CPR (Controlled Products Regulation) and the MSDS contains all of the information required by the CPR.

Inventory

<table>
<thead>
<tr>
<th>Components</th>
<th>Canada (DSL)</th>
<th>Canada (NDSL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tris(2,2'-bipyridyl)dichlororuthenium(II), Hexahydrate</td>
<td>Not Listed</td>
<td>Not Listed</td>
</tr>
</tbody>
</table>

Product code: T2798
Product name: TRIS(2,2'-BIPYRIDYL)DICHLORORUTHENIUM(II), HEXAHYDRATE
Components

<table>
<thead>
<tr>
<th>Tris(2,2'-bipyridyl)dichlororuthenium(II), Hexahydrate</th>
<th>CEPA Schedule I - Toxic Substances</th>
<th>CEPA - 2010 Greenhouse Gases Subject to Mandatory Reporting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not listed</td>
<td>Not listed</td>
<td>Not listed</td>
</tr>
</tbody>
</table>

EU Classification

R -phrase(s)
not determined

S -phrase(s)
none

The product is classified in accordance with Annex VI to Directive 67/548/EEC

Indication of danger:
Not dangerous

16. OTHER INFORMATION

The MSDS format complies with ANSI Z400.1-2004 standards.

Preparation Date
11-Jan-2012

Reason for revision:
Not applicable

Prepared by:
Sonia Owen

Literature reference:
No information available

All chemicals may pose unknown hazards and should be used with caution. This Material Safety Data Sheet (MSDS) applies only to the material as packaged. If this product is combined with other materials, deteriorates, or becomes contaminated, it may pose hazards not mentioned in this MSDS. The physical properties reported in this MSDS are obtained from the literature and do not constitute product specifications. Information contained herein does not constitute a warranty, whether expressed or implied, as to the safety, merchantability or fitness of the goods for a particular purpose. Spectrum Chemicals & Laboratory Products, Inc. assumes no responsibility for results obtained or for incidental or consequential damages, including lost profits, arising from the use of these data. No warranty against infringement of any patent, copyright or trademark is made or implied. It shall be the user's responsibility to develop proper methods of handling and personal protection based on the actual conditions of use. While this MSDS is based on technical data judged to be reliable, Spectrum assumes no responsibility for the completeness or accuracy of the information contained herein.

Product code: T2798
Product name: TRIS(2,2'-BIPYRIDYL)DICHLORORUTHENIUM(II), HEXAHYDRATE