

# Calcium Bromide Liquid Safety and Handling Guide GeoBrom® HG520





# Great Lakes Solutions:

## brominated derivative products for mercury control

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# Emergency Response Telephone Numbers for Bromine

| Country/<br>Region | Emergency Response Provider and<br>Emergency Number*                       |
|--------------------|--|
| United States      | <b>CHEMTREC®</b><br>+1-800-424-9300 or 1-703-527-3887                      |
| Europe             | <b>Carechem 24</b><br>+44 (0) 1235 239 670                                 |
| India              | <b>Carechem 24</b><br>+91 1166 4114 05                                     |
| China              | <b>National Registration Centre for Chemicals (NRCC)</b><br>0532-8388-9090 |

\*Refer to the Safety Data Sheet (SDS) for additional regional emergency response phone numbers.

# Responsible Care® – Doing the Right Thing

Responsible Care® is the chemical industry's health, safety, security, and environmental performance improvement initiative. As an obligation of membership, Responsible Care® is the ethical framework around which American Chemistry Council member and partner companies, including Chemtura Corporation, operate. Responsible Care® is Great Lakes Solutions' commitment to respond to public concerns about the safe management of chemicals and has become the single most important performance improvement initiative within the chemical industry.

Our industry creates products and services that make life better for people around the world—both today and tomorrow. The benefits of our industry are accompanied by enduring commitments to Responsible Care® in the management of chemicals worldwide. We will make continuous progress toward the vision of no accidents, injuries, or harm to the environment and will publicly report our global health, safety and environmental performance. We will lead our companies in ethical ways that increasingly benefit society, the economy, and the environment while adhering to our Responsible Care® Policy.

## Our Responsible Care® Policy

Chemtura considers ensuring the safety and health of the public, our employees, contractors, and customers and the protection of the environment now and for future generations to be our core values. We are committed to meeting all applicable laws, regulations, permits, and internal standards throughout the world. Our goal is zero accidents and incidents, and zero harm to the environment. Continued performance improvement will be achieved with the involvement and commitment of our employees to:

- Conduct business ethically and in accordance with the Guiding Principles of Responsible Care® and the concepts of Sustainable Development.
- Implement the Chemtura Responsible Care Management System®, which integrates environmental, health, safety, and security considerations into daily business practices.
- Improve the safety of processes, reduce the quantity and/or hazard of wastes generated and through our commitment to pollution prevention—minimize or eliminate the release of contaminants into the environment.
- Ensure all products and intermediates are properly registered, comply with applicable regulatory requirements, and may be safely used for their intended purposes.
- Enhance the security of our employees and facilities, our information systems, and our raw materials and finished products throughout the value chain.
- Provide our employees and other stakeholders with appropriate information necessary for their understanding of the environmental, health, and safety aspects of our operations and products; our safety, health, and environmental performance; and the contribution our products make to the quality of life.

**Craig A. Rogerson**  
Chairman, President & CEO



# Introduction

## GREAT LAKES SOLUTIONS, A CHEMTURA BUSINESS

### Product Line

#### GeoBrom® HG520

Calcium bromide solution  
(52% by weight aqueous product)

#### GeoBrom® HG52S

Calcium bromide dry powder

#### GeoBrom® HG400

Sodium bromide solution  
(40% by weight aqueous product)

#### GeoBrom® HG40S

Sodium bromide dry powder

#### GeoBrom® HG480

Hydrobromic acid  
(48% by weight aqueous product)

For more information  
about these products,  
please contact:

Great Lakes Solutions'  
Customer Care

+1-800-428-7947 or  
+1-765-497-6100

### Innovative. Reliable. Sustainable.

For close to a century, we have helped our customers meet their needs with a broad portfolio of products and solutions. We are proud of our history and look forward to helping our customers meet future performance, safety, and compliance requirements. Great Lakes Solutions is dedicated to providing products that are innovative, sustainable, and minimize the impact on our environment and human health without sacrificing performance or quality. We are committed to environmental, health, safety and security performance through the Responsible Care® initiative with handling and stewardship being a critical component of that commitment.

### Geobrom® For Mercury Control

Mercury is released when coal is burned taking three possible forms in the flue gas: elemental, oxidized, and particulate bound. Oxidized and particulate bound mercury can be controlled by existing abatement equipment designed for other pollutants such as Electrostatic Precipitators (ESP), Fabric Filters, and Flue Gas Desulfurization units (FGD or scrubber). However, elemental mercury is gaseous at combustion temperatures and not readily adsorbed by unburned carbon (as measured by Loss On Ignition testing) in the flue gas or injected sorbents.

It is also virtually insoluble in water making it difficult to capture in a traditional scrubber. Therefore, chemical additives have been developed to oxidize the elemental mercury in the flue gas, converting it to a form which can be captured by conventional Air Pollution Control (APC) equipment. This is particularly important for boilers burning low halogen coals where a low percentage of the elemental mercury is oxidized in the boiler.

Bromine and bromine-based compounds are effective in oxidizing elemental mercury which enables its removal from the flue gas of coal-fired power plants with conventional APC equipment. Calcium bromide has been found to be especially effective either alone or in conjunction with sorbents such as activated carbon.

The GeoBrom® product line from Great Lakes Solutions offers sustainable, secure, U.S.-manufactured brominated products for mercury control. These products are designed for incorporation into new technologies that use bromine or brominated derivatives products for the efficient reduction of toxic mercury emission from coal-fired boilers and power plant installations.



# GeoBrom<sup>®</sup> HG520

## Product Description and Properties

GeoBrom<sup>®</sup> HG520 is a clear, colorless to light yellow liquid that is free from foreign materials and solids. GeoBrom<sup>®</sup> HG520 is made from elemental bromine, lime, and water as shown in the chemical reactions below:



### Typical Product Quality

- Appearance: Clear fluid, free from foreign materials
- Calcium Bromide: 51.5% - 53.0%
- Heavy metals content:
  - Arsenic: < 200 ppb
  - Mercury: < 20 ppb
  - Selenium: < 250 ppb
- Chlorides: < 1000 ppm
- pH of neat solution: 6.0 – 7.5

### Physical and Chemical Properties

- Chemical description: halide salt solution containing calcium bromide (CaBr<sub>2</sub>) and water (H<sub>2</sub>O)
- Physical state: liquid
- Odor: none
- Relative density or specific gravity (water = 1): 1.70 – 1.73 at 77°F (25°C)
- Weight/Gallon: ~14.2 lbs.
- Solubility in water: miscible
- Crystallization point 14.2 ppg fluid: 10-20°F (see table that follows)
- Boiling point = 264°F (129°C)



## GeoBrom® HG520 Crystallization Temperatures

The crystallization temperatures shown in the table below are the temperatures of the bulk liquid in the storage or transport vessel and not ambient air temperature around the vessel. For example, material having the typical density of 14.2 lbs/gal must cool to 10°F before crystallization in the storage vessel occur. Although the outside air temperature may be below the crystallization temperature, crystallization will not occur because the liquid inside is still above the temperature. Highlighted lines indicate

the typical product concentration range for GeoBrom® HG520, which is 51.5-53.0% calcium bromide (CaBr<sub>2</sub>).

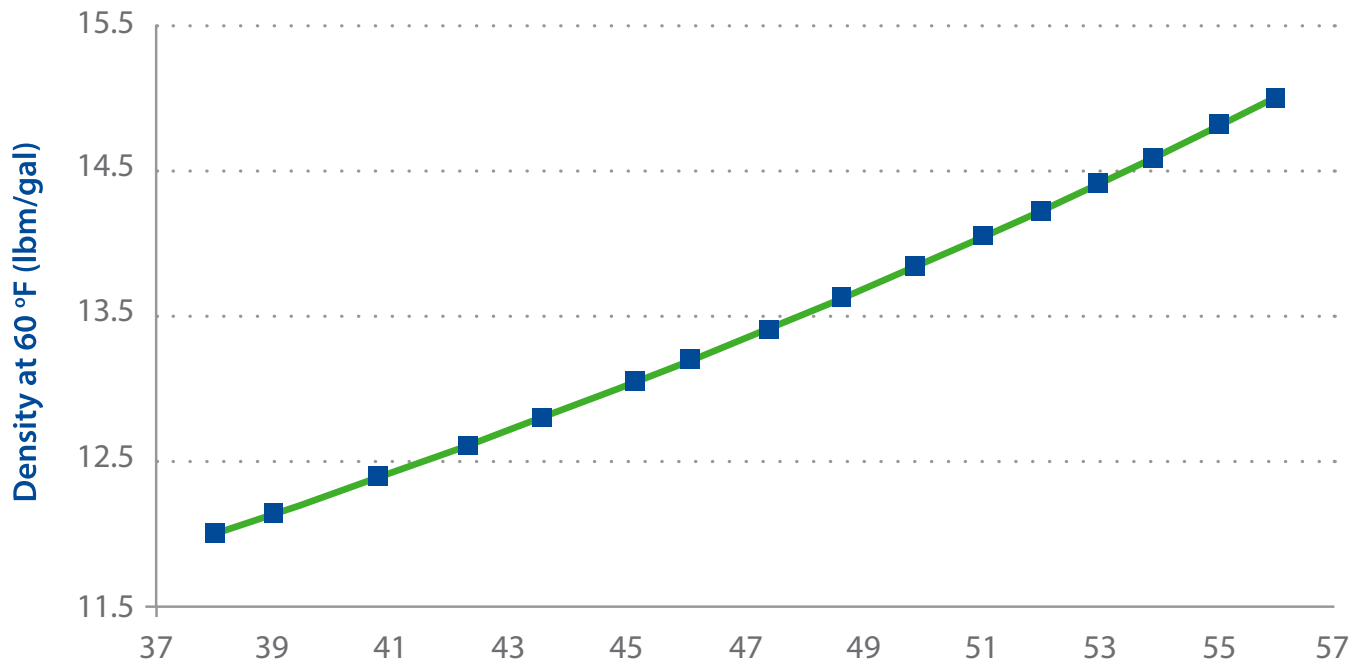
GeoBrom® HG520 has a heat capacity similar to water and holds a significant amount of heat even at typical storage temperatures. Under normal storage conditions in vessels containing a large mass of material, there is enough heat contained such that the material takes many days to cool to temperatures of concern.

Chemtura has conducted studies to determine the heat loss and temperature drop expected in worst case winter conditions and has determined that material at a temperature of 25°F loaded onto a railcar and transported in ambient temperatures of 10°F is expected to be 14°F after 17 days. Given this “worse than typical” scenario, crystallization is not expected even during the winter in northern climates.

| Density at 60 °F<br>(lbm/gal) | Specific Gravity<br>(water = 1) | CaBr <sub>2</sub> (%) | Crystallization<br>Temperature (°F) | Crystallization<br>Temperature (°C) |
|-------------------------------|---------------------------------|-----------------------|-------------------------------------|-------------------------------------|
| 12.0                          | 1.441                           | 37.98                 | -50                                 | -45.6                               |
| 12.2                          | 1.465                           | 39.44                 | -61                                 | -51.7                               |
| 12.4                          | 1.489                           | 40.84                 | -73                                 | -58.3                               |
| 12.6                          | 1.513                           | 42.22                 | -88                                 | -66.7                               |
| 12.8                          | 1.537                           | 43.54                 | -96                                 | -71.1                               |
| 13.0                          | 1.561                           | 44.84                 | -78                                 | -61.1                               |
| 13.2                          | 1.585                           | 46.09                 | -63                                 | -52.8                               |
| 13.4                          | 1.609                           | 47.31                 | -43                                 | -41.7                               |
| 13.6                          | 1.633                           | 48.50                 | -34                                 | -36.7                               |
| 13.8                          | 1.657                           | 49.66                 | -20                                 | -28.9                               |
| 14.0                          | 1.681                           | 50.78                 | -7                                  | -21.7                               |
| 14.2                          | 1.705                           | 51.88                 | 10                                  | -12.2                               |
| 14.4                          | 1.729                           | 52.95                 | 23                                  | -5                                  |
| 14.6                          | 1.753                           | 53.98                 | 36                                  | 2.2                                 |
| 14.8                          | 1.777                           | 54.99                 | 50                                  | 10                                  |
| 15.0                          | 1.801                           | 55.97                 | 61                                  | 16.1                                |

Data from Completion and Workover Fluids by Kenneth Bridges, SPE Monograph Series, Vol. 19, Henry L. Doherty Series, p. 42.  
Note: highlighted lines represent the concentration/density range expected for our product as delivered to the customer.

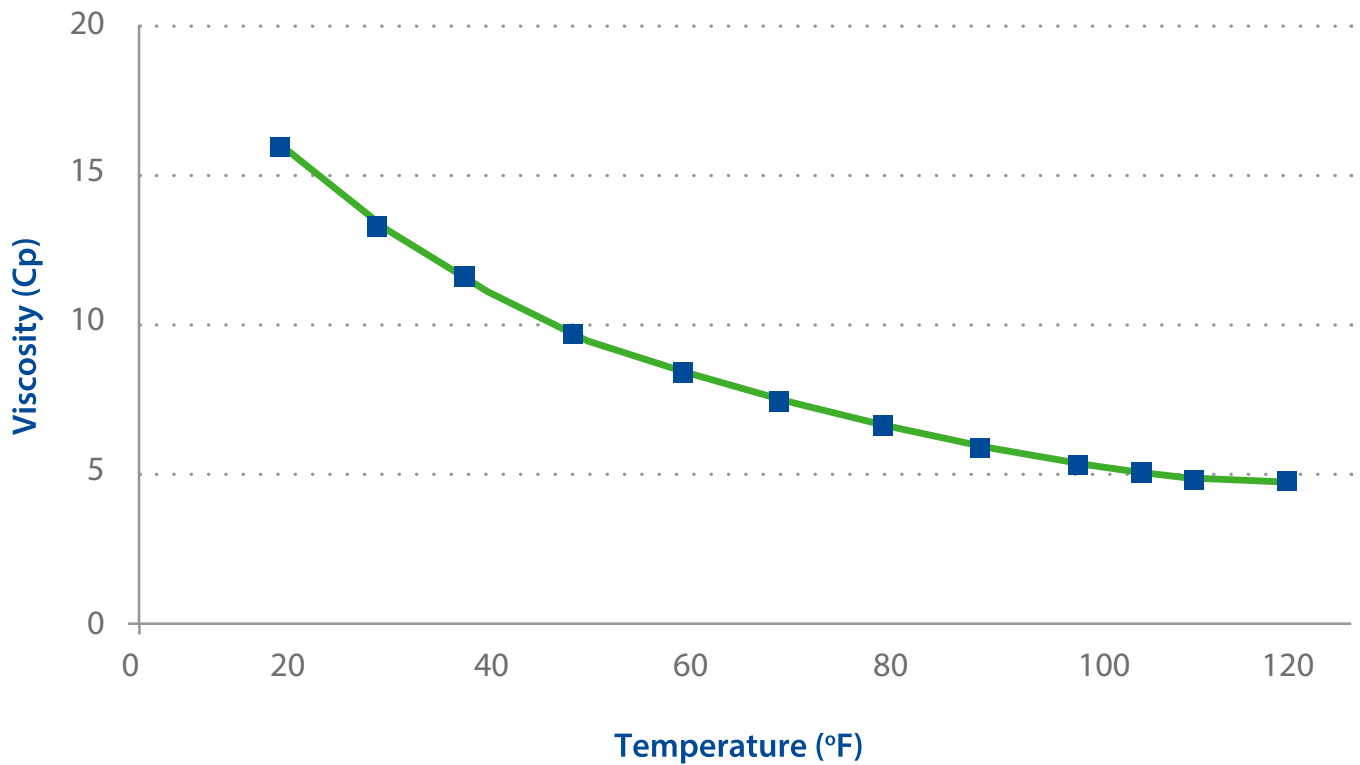
## GeoBrom® HG520 Density Concentration Relationship at 60°F



## Weight % CaBr2 GeoBrom® HG520 Viscosity/Temperature Relationship

| Temperature (°F) | Temperature (°C) | Viscosity (Cp) |
|------------------|------------------|----------------|
| 15.0             | -9.4             | 15.8           |
| 25.0             | -3.9             | 13.1           |
| 35.0             | 1.7              | 11             |
| 45.0             | 7.2              | 9.3            |
| 55.0             | 12.8             | 8.24           |
| 65.0             | 18.3             | 7.23           |
| 75.0             | 23.9             | 6.43           |
| 85.0             | 29.4             | 5.7            |
| 95.0             | 35.0             | 5.12           |
| 100.0            | 37.8             | 4.83           |
| 105.0            | 40.6             | 4.67           |
| 115.0            | 46.1             | 4.49           |

## GeoBrom® HG520 Viscosity (Cp) vs. Temperature (°F)



## Environmental, Health, Safety and Regulatory Summary

### CAS Registry No.:

- 7789-41-5 calcium bromide
- 7732-18-5 water

### EINECS No.:

- 232-164-6 calcium bromide
- 231-791-2 water

### Flash Point:

None: this product is not flammable. However, fire can produce fumes from decomposition. SCBA and other required PPE must be worn when responding to a fire emergency involving this product.

### Materials to avoid:

Strong oxidizers

### Hazardous reactions:

Will not occur

See SDS for additional information.

# Regulatory Information and Training

Personnel handling chemicals should be trained in accordance with the applicable federal and state occupational safety and health standards. In the U.S., these training requirements could include, but may not be limited to, the following:

- Hazard Communications (29 CFR 1910.1200)
- Personal Protective Equipment (29 CFR 1910.132)
- Respiratory Protection (29 CFR 1910.134)
- Occupational Noise Exposure (29 CFR 1910.95)
- Hazardous Materials Transportation (49 CFR 172.700)
- Environmental Protection Agency (EPA) regulations (40 CFR)





# Procedures for the Safe Handling of Calcium Bromide Liquid

Visit our website to obtain a copy of the product data sheet.

## Personal Protective Equipment (PPE)

- Rubber boots
- ANSI approved safety glasses
- ANSI approved hard hat and face shield and/or goggles to protect eyes
- Rubber or Neoprene gloves
- Slicker suit or chemical resistant smock
- Suitable respiratory protection if exposed to vapors or mist, e.g. NIOSH/MSHA approved organic/acid gas cartridge respirator

## Safety and Handling

The Great Lakes Solutions business of Chemtura has many years of experience in the safe production, handling, transport, storage and use of bromine and bromine-based compounds. We are committed to sharing our expertise with our customers to enhance their capabilities to handle the products safely. If you have technical or safety related questions regarding GeoBrom® HG520 in your facility, we encourage you to contact us for assistance. Assistance can include the following:

- Visit to your storage and handling facilities
- Training of personnel
- Review of your operating and maintenance procedures
- Site visit safety review

## Safety and Handling

- Skin irritation with contact
- Eye irritation with contact
- Inhalation can cause irritation to the mucous membranes of the nose, mouth and throat
- Swallowing may cause irritation to mucous membranes of gastrointestinal system
- PPE should be worn when transferring or handling this product
- Safety/emergency plans and procedures should be in place for release and general activities
- Transportation regulations do not designate the product as hazardous; however, precautions should be taken to ensure containment at all times
- Use best engineering practices
- All valves, lines and connections should be well labeled and accessible for use



Typical PPE for handling GeoBrom® HG520

## Environmental Considerations

- Avoid releasing this product to the environment (unloading procedures are available upon request)
- Dispose of waste materials in accordance with federal, state, and local regulations, requirements, and guidelines

## Spills

- Response personnel must be familiar with liquid CaBr<sub>2</sub>
- Wear appropriate and required PPE
- When responding to spills, use the “buddy system”
- Spills may cause a severe slipping hazard. Rope/cordon off the area where a small spill has occurred and restrict unnecessary traffic during clean-up.
- If possible capture spills in buckets or other containers
- If it can be done safely, stop the flow of product
- Contain the spill with spill pillows or earthen dikes
- Transfer the captured material to an appropriate container for disposal (see section on “Equipment and Materials of Construction” for guidance). Label container per established procedures.
- Notify plant personnel and regulatory groups per requirements to report spillage if quantity of spilled product triggers those requirements
- Call in back-up support as needed to aid in clean-up and containment efforts
- Wipe/remove any residual product left on the product container

## Recommended Storage Practices

GeoBrom® HG520 is inherently stable under recommended storage conditions and will not decompose or polymerize provided the solution is not contaminated with foreign or incompatible materials. However, the best practice recommendation is to use product within one year of receipt.

- Outdoor: tanks in colder regions should be insulated and have re-circulation capability. The use of heat tracing and blanketing should also be considered.
- Over-fill alarms or tank level indicator for storage tanks

# Emergency Procedures

## Emergency Equipment And Supplies

- Required PPE
- Eye-wash and shower stations
- Containment and spill kits
- Buckets and containers for spills
- Access to phone or radio for communication
- Emergency Contact List (safety numbers and plant contacts)

## Transportation Emergencies

- Contact CHEMTREC®, Carechem 24 or the NRCC; whichever is appropriate for your specific region – see page 4 for the appropriate contact numbers

## Fire

- GeoBrom® HG520 is not flammable; however, fire can produce fumes from decomposition. SCBA and other required PPE must be worn when responding to a fire emergency involving this product.
- Concerns with fire include:
  - Proximity of incompatible or reactive materials. Avoid storing strong oxidizers near this product.
  - Boiling liquid expanding vapor explosion (BLEVE) due to pressure build-up in storage tank



# First Aid

## Skin

- Required PPE
- Eyewash and shower stations
- Containment and spill kits
- Buckets and containers for spills
- Access to phone or radio for communication
- Emergency Contact List (safety numbers and plant contacts)

## Eye

- Use eyewash station immediately. Hold eyelids apart and flush eyes for at least 15 minutes with copious amounts of water. Seek medical attention.

## Inhalation

- Move person to fresh air. Seek medical attention

## Ingestion (Swallowing)

- If the person is conscious, have him drink 1-2 glasses of water and seek medical attention immediately.

**See SDS for additional information.**

# Equipment and Materials of Construction

## Storage tanks

- 316 stainless steel
- Carbon steel
- Lined-carbon steel
- Fiberglass reinforced plastic

## Storage tank lining material

- ATLAC 382-05A or similar polyester resins
- Plasite 9570, Plasite 9571, Plasite 9573

Lined storage units have better corrosion resistance and will reduce the incursion of iron and color into the product during long-term storage. Equipment and lining manufacturers should be consulted to ensure that the proper lining material is chosen for operational and environmental conditions for a specific plant site. Best engineering practices should be applied when designing a bromide solution storage unit.

## Piping

- Stainless steel 316
- Lined carbon steel
- Suitable plastics, e.g. polypropylene

*Note: plastic piping should be configured and supported to prevent any strain that could potentially crack or break the plastic pipe under load.*

## Hoses

- Braided steel covered PTFE equipped with carbon steel flanges
- Flange gaskets should be a PTFE sandwich design

## Valves

- Ball, plug or diaphragm type
- Material similar to piping (stainless steel 316)
- Pumps – Centrifugal type



# Corrosion Studies Summary

## GeoBrom<sup>®</sup> HG520

Great Lakes Solutions conducted corrosion studies with GeoBrom<sup>®</sup> HG520 to determine appropriate materials of construction for storage vessels and other equipment associated with handling this material. Several common metals were selected and evaluated at typical storage and handling temperatures. The results, summarized below, are to be used as a guide when designing and installing a storage vessel for GeoBrom<sup>®</sup> HG520.

- 90 day tests on coupons of six metals (C-1018, 304W, 316LW, 2205, 304LW, 316) tested with GeoBrom<sup>®</sup> HG520 (52% CaBr<sub>2</sub>)
- Temperature of 20°C and 50°C
- ASTM Method “Standard Practice for Preparing, Cleaning, and Evaluating Corrosion Test Specimens” G1-03 (reapproved 2011)
- Total Immersion
  - All less than 2.0 mpy
  - C-1018 highest rates at 0.32 mpy for 20°C and 1.29 mpy at 50°C
  - All other samples <0.05 mpy
- Vapor exposure
  - All less than 0.06 mpy
  - C-1018 highest rates at 0.025 mpy for 20°C and 0.053 mpy at 50°C
  - All other samples <0.015 mpy
- Partial Immersion (half vapor/half liquid)
  - Liquid immersed is typically where corrosion occurred
  - All less than 0.70 mpy
  - C-1018 highest rates at 0.14 mpy for 20°C and 0.65 mpy at 50°C
  - All other samples <0.10 mpy

In conclusion, good results were observed with most of the metals showing little to no corrosion. The choice of metal depends on equipment performance needs, cost, and availability. Other non-metallic materials such as FRP, Teflon<sup>®</sup>, glass-lined steel, etc. are also satisfactory for contact with GeoBrom<sup>®</sup> HG520. Download the full study at [www.greatlakes.com](http://www.greatlakes.com) (add whole address when available) for complete details.

# Shipping Containers and Transportation

## Shipping Containers

### Bulk trucks

45,000 lbs. net weight (3,170 gallons); Air Offload at 12-25 psi

### Railcar

- Net weight 180,000 lbs. (~12,700 gallons)

### IBC tote

- Net/tare weights: 4,200 lbs. / 138 lbs.
- # Totes/pallet: 1
- Tote material of construction: HDPE
- Container return procedure:  
call Chemtura Customer Care at 800-428-7947 for instructions

### Polyethylene drum

- 780 lb. net weight (824 lbs. gross wt.)
- Net/tare weights: 780 lb. / 44 lb. (~55 gallons)
- # Drums/pallet: 4
- Drum material of construction: HDPE
- Container return procedure:  
call Great Lakes Solutions Customer Care at 800-428-7947 for instructions

*Container unloading procedures available upon request.*

## Transportation

- GeoBrom® HG520 is classified as “not dangerous goods” by the Department of Transportation (DOT), TDG, IATA, and IMDG
- UN Number: not regulated
- Shipping Class: chemicals, N.O.I.
- Containers must be rated to handle at least a 14.2 pounds per gallon fluid
- Colder climates will require line insulation and an ability to heat and circulate the product to manage product temperature



# Contact Information

For further information please contact your sales representative or visit our website at [www.chemtura.com/geobrom](http://www.chemtura.com/geobrom).

In an emergency, please contact our emergency response partners:

Chemtrec (North America) 1-800-424-9300

Care Chem 24 (all non-North America countries) +44 (0) 1235 239670

See (M)SDS for additional and most up-to-date product regulatory guidance as well as country-specific emergency response phone numbers.

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## Great Lakes Solutions Disclaimer For The Geobrom® Calcium Bromide Liquid HG 520 Safety and Handling Guide

Great Lakes Solutions, a Chemtura business, provides this GeoBrom® Calcium Bromide Liquid Safety and Handling Guide solely for the convenience of its customers and their employees and contractors who are experienced and competent in the handling and use of calcium bromide liquid.

The user of this guide assumes all risk of the use of the information contained in this manual and the results of such use. The advice and recommendations are based upon technical data which Chemtura believes to be reliable and are intended for use by persons having the requisite skills which use is at their own discretion and risk. Each customer must make an assessment of the products to determine whether they

are suitable for use in their formulations and specific applications and can be utilized in a safe and effective manner. In no event shall Chemtura be liable for any direct, indirect, special or consequential damages arising out of the use of the information we provide on our products.

Nothing in this guide is intended or is to be construed as a recommendation by Great lakes Solutions to use, reuse, further manufacture, sell, or import/export calcium bromide solution in a manner that: (i) infringes any patent, trademark, copyright, trade secret, or other intellectual property rights of any third party in any jurisdiction; (ii) violates the law; or (iii) does not meet the standard of care generally prevailing in the United States.

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NOTHING IN THIS GUIDE SHALL BE CONSTRUED TO CONSTITUTE A REPRESENTATION OR WARRANTY, EXPRESS OR IMPLIED, REGARDING THE PRODUCT'S CHARACTERISTICS, USE, QUALITY, SAFETY, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

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The information contained herein is correct to the best of our knowledge. Your attention is directed to the pertinent Material Safety Data Sheets for the products mentioned herein.

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or to email us, visit us  
on the web at:

[www.greatlakes.com](http://www.greatlakes.com)

