Product Stewardship Summary

CAS: 7726-95-6
Formula: Br

Bromine

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Introduction

Bromine is a chemical element, one of nature's building blocks. It is so common in nature that it is even found in our bodies and in the foods we eat.

Bromine derivatives are essential ingredients in everything from drugs and automotive tires to water purifiers, sanitizers and additives that protect lives and property from fire. We use them to explore for oil and gas, and they help us keep our swimming pools and spas clean and clear. They are vital to agriculture and international trade because they protect crops from insect damage and help to keep imported commodities free of invasive pests.

Most bromine is derived from bromine-containing compounds found in seawater and underground brine deposits. Although elemental bromine is very toxic, it is so reactive that it cannot exist in nature in pure form. The risk of exposure is therefore low.

Because it is toxic, government carefully regulates the way we handle and transport bromine, and producers and transportation companies take special care to handle it safely.

Description and Properties

Bromine is a dense, dark reddish-brown liquid that is more than three times as heavy as an equivalent volume of water. At room temperature bromine easily turns into an irritating vapor with a sharp, penetrating odor. The vapor is heavier than air and is very corrosive to common metals such as steel and aluminum. Bromine is only slightly soluble in water and although it isn't flammable, bromine is so highly reactive that it may ignite combustible materials. Bromine is very toxic and causes severe burns to the skin and eyes.

Uses

Bromine-containing compounds are nearly everywhere you look. Roughly 90 percent of all electrical components contain flame retardants made with bromine. These valuable compounds protect lives and property by slowing the spread of fire in cell phones, stereos and other electronic equipment, as well as insulation, furniture, mattresses, fabrics, draperies and carpeting.

Large amounts of bromine derivatives called clear brine fluids are used in oil and gas exploration, where their high density helps to control the extreme pressures found in deep wells. These high-density clear-brine fluids also protect the environment by preventing fluids from migrating between underground formations through the well bore.




Bromine-containing compounds purify drinking water on navy ships and offshore oil rigs, and they keep swimming pools and spas clean and free of contaminants. There's a good chance that your favorite citrus-flavored soft drink owes its taste in part to the brominated vegetable oil used as an emulsifier.

Bromine also is an essential building block used to make a variety of prescription drugs and over-the-counter medications, from pain relievers, cough medicine and sleep aids to experimental treatments for Alzheimer's disease, cancer and AIDS.

A number of essential crop chemicals are derived from bromine, as well. Without them, insects and plant disease would cause more damage to valuable crops and stored commodities. World trade in grain, fruits and vegetables would suffer, and it would become far more difficult to control invasive pests that contaminate foodstuffs and threaten native species.

Bromine is very important in transportation, as well. Rubber is reacted with bromine to improve tire strength and resistance to leakage. It also is an antiknock additive in leaded gasolines that are being phased out, but are still widely used in some developing countries, and is becoming increasingly important in pollution-control applications at power plants. Future potential uses include the high-capacity batteries we need to make zero-emissions electric cars practical.

Health Information

Bromine is toxic if inhaled or swallowed. Trace amounts can trigger acne, and at relatively low concentrations it can cause watery eyes and skin redness, as well as coughing, dizziness, headache and nose bleeds. In higher concentrations bromine causes blisters and severe burns, and can cause vomiting or loss of consciousness. Long-term complications from high exposures can include pneumonia.

Bromine converts rapidly in nature to bromine-containing compounds called bromides. Some of these compounds can depress the central nervous system, a characteristic that led to their use in medicine. These effects tend to disappear when exposure is stopped.

Exposure Potential

Bromine is regulated at the local, state, and federal level as a hazardous material, and chemical plants are required by law to publish and follow strict safety procedures designed to protect workers from bromine exposure. Nonetheless, chemical and transportation workers likely have the highest risk of exposure. Protective clothing and required safety equipment are designed to minimize this risk and are required by law when handling the material.



The U.S. Environmental Protection Agency has determined that the very low levels of bromine in drinking water on navy ships and oil platforms pose minimal risks, and that adequate controls are in place to ensure bromine levels remain below the EPA food-additive tolerance level.

Because bromine doesn't occur in nature in pure form, exposure is unlikely elsewhere unless there is an accidental release or spill. In that event, exposure is most likely near the site of the spill, downwind, and especially in low areas where bromine will tend to accumulate due to its high density.

Environmental Information

If water became contaminated with enough elemental bromine, it would become highly toxic to freshwater fish and other aquatic organisms. Likewise, if elemental bromine was released into the atmosphere and inhaled in sufficient concentration, it would be extremely toxic to humans and other animal life.

By reducing the number and scale of damaging fires, bromine-containing flame retardants cut the volume of hazardous combustion byproducts that would otherwise contaminate our air, soil and water. And because they are considered easier to recycle than similar compounds made with other elements, bromine-containing flame retardants may be less likely to accumulate in landfills as industry increases its reliance on recycling.

Bromine is widely distributed in nature, where it is found in seawater and volcanic rocks, but it never occurs naturally in pure form because it is so reactive. Instead it is most often found in compounds containing other elements. Many of these natural "bromides" are very common in plants and animals, including human tissues and blood, and many others are found in the foods we eat, both man-made and organic.

Physical Hazards

Bromine is a powerful oxidizing agent that can ignite combustibles on

contact. It reacts explosively with potassium, reacts vigorously with aluminum and attacks many other common metals, including iron, steel, stainless steel and copper. Bromine also attacks some forms of plastics, rubber and coatings. Because of this reactivity, special materials must be used to transport and store it.

Bromine vapor is highly corrosive, and becomes more so in the presence of moisture due to the formation of acids. In most cases, bromine must therefore be kept dry during transportation and storage.

Because bromine is much heavier than an equivalent volume of water, handling and transportation systems must be designed and operated properly to reduce the risk of potentially hazardous imbalances and load shifting.

Derivation/Manufacturing

Bromine is very common in nature, but the highest concentrations are found in seawater, salt lakes and the underground brines that are often associated with oil and gas deposits. In the United States, most bromine is extracted from underground brine deposits in Arkansas. The Dead Sea is the most important source of bromine in the Middle East.

The United States, Jordan and Israel produce more than three-quarters of the world's bromine, but China, India and Japan also are important sources. Increasing volumes of bromine and bromine derivatives are produced as byproducts of various chemical reactions, and this helps to reduce the amount of bromine in industrial waste.

Regulatory Information

Bromine is classified as a hazardous waste material under the CERCLA (Superfund) act of 1980 and the Resource Conservation and Recovery Act (RCRA) of 1976, along with numerous state and local laws and regulations. Under these rules, bromine must be disposed of in a way that minimizes potential harm to humans and the environment.

In the United States, bromine is a FIFRA-registered pesticide and the Environmental Protection Agency requires labels indicating toxicity to fish and aquatic organisms. OSHA lists bromine as an air contaminant, and the Department of Transportation identifies bromine as an inhalation hazard.

Use of bromine is regulated under portions of the U.S. Clean Air act governing toxic substances. The federal Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986 includes bromine under its Toxics Release Inventory, which requires certain manufacturing companies to report environmental releases and transfers.

Product Stewardship

Albemarle is committed to manage bromine manufacturing and handling so that the product can be transported and used safely. We minimize risks of leakage, personnel exposure and environmental impact by specifying appropriate transportation and storage containers, procedures and protective equipment.

Albemarle publishes and monitors a 24-hour emergency response number, along with an incident-reporting and corrective-actions program for transit incidents. We produce and supply training materials for organizations that handle bromine, and we require transportation firms to meet strict safety standards before loading the product.

Prior to selling bromine to any potential customer, we assess the entire distribution chain from loading through use of the product, and we repeat this process periodically thereafter with each customer as described in the American Chemistry Council's Responsible Care Security Code.

Previous customer experience and their intended use are reviewed and, depending on the results, an on-site evaluation may be conducted in which Albemarle will interview the firm's management and employees, review their documentation and inspect their facilities. The process covers industrial hygiene, safety, environmental considerations, process and transportation equipment, emergency preparedness, record-keeping and regulatory compliance.

Albemarle provides detailed guidance in proper bromine handling and storage, as well as emergency response procedures, and we foster open relationships in which we encourage our customers to report problems and actively participate in audits of their systems and procedures.

Albemarle will not allow any driver to load bromine at its facilities without first documenting his or her participation in bromine driver-safety training within the past 12 months. Regardless of experience, every driver also must watch a short film prior to departure that reviews safe handling and emergency procedures. Drivers in the European Union must show proof that they are properly equipped and trained according to EU directives governing transportation of hazardous materials ("ADR").

Conclusion

Although bromine in pure form is a hazardous material that is carefully regulated for public safety, bromine derivatives are essential to our health and way of life. Our bodies contain them, and so do many of the foods we eat. We rely on them to treat illnesses and protect our crops, and we use them to produce everything from electronic equipment to sanitizers, tires, dyes and photographic film.

Because bromine is both reactive and toxic, we take care to use it in ways that minimize its release into the environment. Fortunately bromine is abundant because its properties are so numerous and so valuable that scientists continue to explore promising new uses to make our lives healthier, safer and more comfortable.

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How to Contact Us

You can write us for additional information at: Albemarle Corporation
Responsible Care Coordinator
451 Florida Street
Baton Rouge, LA 70801-1765

Or e-mail us at: HSE@albemarle.com

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