SALT

By Dennis S. Kostick

Domestic survey data and tables were prepared by Jeffrey A. Milanovich, statistical assistant, and the world production table was prepared by Regina R. Coleman, international data coordinator.

Salt, also known as sodium chloride, comprises the elements sodium and chlorine. Sodium is a silver-colored metal that is so unstable that it reacts violently in the presence of water, and chlorine is a greenish-colored gas that is dangerous and may be lethal. Yet the combination of these two elements forms sodium chloride that is a white-colored compound essential to life itself. Virtually every person in the world has some direct or indirect contact with salt daily. People routinely add salt to their food as a flavor enhancer or apply rock salt to walkways to remove ice in the winter. Salt is used as feedstock for chlorine and caustic soda manufacture. These two inorganic chemicals are used to make many consumer-related end-use products, such as polyvinyl chloride (PVC), a plastic made from chlorine, and paper-pulping chemicals manufactured from sodium hydroxide (caustic soda).

In 2003, U.S. salt production increased by 8% compared with the previous year to 43.7 million metric tons (Mt). World production increased to about 210 Mt from 115 countries; the United States remained the world leading salt-producing country with 21% of total world output.

Domestic Data Coverage

U.S. production and sales data for salt are developed by the U.S. Geological Survey (USGS) from an annual voluntary canvass of U.S. salt-producing sites and company operations. Production refers to the quantity of salt mined or manufactured that is available for sale. Salt sold or used is the quantity of salt that was sold directly to customers or used captively by the salt producer, which usually is a chloralkali (chlorine and sodium hydroxide) manufacturer.

Of the 29 companies to which a canvass form was sent, all but 1 responded (Dow Chemical Co.), representing 87% of the total production shown in this report. Data for the nonrespondent were estimated based on responses to previous annual surveys, the 2003 production estimate survey, or brine production capabilities for chloralkali manufacture based on published chlorine production capacities [1.75 metric tons (t) of salt required per ton of chlorine capacity].

Production

The structure of the U.S. salt industry has changed throughout the years. In 1970, 50 companies operated 95 salt-producing plants in the United States. Market competition, energy and labor costs, less expensive imports, currency exchange rates, and an excess of production capacity (resulting in the downsizing of the industry through mergers and acquisitions) reduced the number of operations in the industry to 29 companies and 64 plants by 2003.

The four types of salt that are surveyed are classified according to the method of recovery as follows: rock salt, from the surface or underground mining of halite deposits; solar salt, from the solar evaporation of seawater, landlocked bodies of saline water, or primary or byproduct brines; vacuum pan salt, from the mechanical evaporation of a purified brine feedstock; and brine, from the solution mining of underground halite deposits. Data for brine production and consumption represent the anhydrous salt content only and not the weight of the water.

***Mining.*—Rock Salt.**—Rock salt is mined by the room-and-pillar method, which is similar to that used in coal and trona mining. The pillar widths are controlled by the percentage of extraction permissible at the various depths and room widths. Most room-and-pillar operations recover about 45% to 65% of the resource, with the remainder left behind as pillar supports for structural integrity of the mine. The salt is drilled, cut, blasted, mucked, crushed, and transported to the surface for processing, which usually involves removing the impurities and screening the material to finer size fractions.

Underground mining practices of bedded halite (commonly referred to as "rock salt") and domal salt formations are similar except for the height differences within the mines of the two types of operations. For example, bedded formations usually are laterally extensive but are vertically restricted. Salt domes are laterally restrictive but are vertically extensive. Many salt domes have depths in excess of 6,100 meters (m) (20,000 feet), yet many outcrop at the surface. Most Gulf Coast salt mining operations are generally less than 300 m (1,000 feet) below the surface. Working at deeper depths is difficult because of higher temperatures and denser rock.

Solar Evaporation.—Solar evaporation uses the wind and the sun to evaporate the water and is an effective method of producing solar salt in areas of high evaporation and low precipitation. Along coastal margins in many parts of the world, seawater is collected and allowed to evaporate in specially constructed concentrating and evaporating ponds. Seawater contains various dissolved salts that will separate depending on their relative solubilities. Calcium carbonate, which is the least soluble, will separate out first. Highly soluble magnesium salts tend to separate last. The order of separation of mineral salts from seawater from first to last are calcite, gypsum, halite, astrakainite, epsomite, kainite, hexahydrite, kieserite, carnallite, and bishofite. Saline lake water is also processed using solar evaporation. The ponds are separated by levees that isolate the brine during different stages of fractional crystallization.

The brine is circulated among a network of interconnecting ponds, with salinity increasing with each transfer. The brine is then treated with lime to remove excess calcium sulfate, pumped to evaporation ponds, and then transferred to harvesting ponds to permit the salt to crystallize. After about 85% of the salt is

precipitated, the remaining supernatant liquid, called "bitterns," can be pumped to adjacent ponds for subsequent extraction of bromine, magnesium, potassium, and sodium compounds. The harvesting pond is flooded again with new brine from the lime pond to repeat the cycle. It takes about 5 years, once seawater is first introduced into the system, for the completion of the crystallization process. The salt is harvested by special tractors equipped with scrapers and is ready for processing.

Solution Mining.—The first reported use of solution mining was about 250 B.C. in China when holes were drilled into deep salt deposits. The brine was brought to the surface by pipes made of bamboo. The brine was evaporated over fires fueled with coal, wood, or unprocessed natural gas. The basis of current technology began in France around A.D. 858. Today, an injection well is sunk, and pressurized freshwater is introduced to hydraulically fracture the bedded salt. Once communication with the production well is established, the brine is pumped to the surface for treatment. Solution mining can also use annulus injection, which uses a pair of concentric pipes (one carries the solvent downward and the other containing the brine upward), or tubing injection, which introduces the solvent at the bottom of the tube.

Solution mining is used to obtain a sodium chloride feedstock for vacuum pan salt production and for chlorine, caustic soda, and synthetic soda ash (excluding the United States) manufacture. The quantity of underground salt dissolved and recovered as brine to make vacuum pan salt usually is not reported as primary salt production, only the quantity of vacuum pan salt manufactured is reported. The quantity of brine used to make chloralkali chemicals is reported as either the amount of captive brine used or brine sold. The chemical industry is the leading consumer of salt brine in the world.

***Processing.*—Rock Salt.**—About 81% of total rock salt produced and imported is used for highway deicing. Crushing and screening to the proper physical size is usually the only processing that road salt undergoes. In many operations, these steps are done underground in the mine to minimize haulage and storage costs. In addition, the extremely fine fraction, which often is unusable and would represent a waste product if brought to the surface, remains underground.

Solar Salt.—After harvesting, the salt crystals are washed with dilute brine to remove residual bitterns and impurities. The salt is transferred to processing facilities where it is washed with saline water, dried for about 8 minutes at approximately 160° C (300° F), and screened into fine to coarse sizes, depending on the end use of the salt to be sold. Most operations ship solar salt in bags and in bulk, using barges, rail, and truck transportation.

Mechanical Evaporation.—Vacuum pan salt is not mined but is a type of salt produced using mechanical evaporation technology. Although rock salt, solar salt, and salt brine may be used to make vacuum pan salt, virtually all domestic vacuum pan salt is obtained from solution mining underground salt formations. Vacuum pan salt is obtained by dehydrating brine using heat alone or in combination with a vacuum. The vacuum pan process conserves energy by utilizing multiple-effect evaporators connected to vacuum pumps. A saturated salt solution will boil at a higher temperature than pure water. When a vacuum is applied, the brine boils at a lower temperature, enabling the superheated vapor that is generated to act as the heating medium for the next evaporator.

The grainer or open pan process uses open, rectangular pans with steam-heated immersion coils to evaporate the water in the brine. Rotating rakes scrape the salt precipitate into a sump or up a ramp, depending on the method, and onto conveyors for debrining and drying treatment. The final product is usually flake shaped rather than the typical cubic form. Flake salt is preferred for production of baked goods, butter, and cheese.

The Alberger process is a modified grainer operation that produces cubic salt with some flake salt. The pans are shallow circular units with external heating units rather than heating coils. The open pan process cannot be operated successfully in regions with high humidity levels because the evaporation rate is too slow and more energy is required to evaporate the brine.

Production in 2003.—Total U.S. salt production increased by more than 8% in 2003 to 43.7 Mt compared with that of 2002 (table 1). According to the USGS canvass for 2003, 29 companies operated 64 salt-producing plants in 15 States. Of these, 10 companies and 16 plants produced more than 1 Mt each and accounted for 91% and 66%, respectively, of total U.S. production and 90% and 34%, respectively, of total value. Several companies and plants produced more than one type of salt. In 2003, 9 companies (12 operations) produced solar-evaporated salt; 6 companies (17 operations), vacuum pan salt; 11 companies (15 operations), rock salt; and 14 companies (32 operations), salt brine.

The five leading States, in descending order of total salt sold or used, were Louisiana with 31%; Texas, 23%; New York, 13%; Kansas, 7%; and Utah, 5%. Other Eastern States (Alabama, Michigan, Ohio, Tennessee, and West Virginia) accounted for 18% of the domestic total salt sold or used. Other Western States (Arizona, California, Nevada, New Mexico, and Oklahoma) represented 3% (table 4).

In February 2001, IMC Global Inc. sold its salt company, IMC Salt Company, to refocus on its core crop nutrient businesses. This divestment included the rock salt operations in Louisiana, Canada, and the United Kingdom; a vacuum pan salt plant in Kansas; and the solar salt facility in Utah. In October, the salt assets were sold to Apollo Management L.P., a New York-based private investment firm, for $640 million, including $600 million in cash. The salt businesses were renamed Compass Minerals Group, Inc., of which Apollo Management owned 80%, and IMC Global, the remaining 20%. The U.S. salt operations were known as North American Salt Co., the Canadian plants as Sifto Canada, Inc., and the British facilities as Salt Union Ltd. In early 2003, IMC Global sold a 15% share of Compass Minerals for $60.5 million to Salt Holdings Corp. (Compass Minerals' parent company). IMC Global retained a 4.9% share (Industrial Minerals, 2003). In November, Salt Holdings Corp. changed its name to Compass Minerals International, Inc. and filed a registration statement with the Securities and Exchange Commission for an initial public offering of common stock (Compass Minerals International, 2003§[1]).

[1]References that include a section mark (§) are found in the Internet References Cited section.

Consumption

In 2003, apparent consumption (salt sold or used plus imports minus exports) was 53.2 Mt, whereas reported consumption (sales or use as reported by the salt companies, including their imports and exports) was 50.2 Mt. Although these two measures of consumption are not necessarily expected to be identical, they normally are similar. Apparent consumption normally is greater than reported consumption because apparent consumption includes additional quantities of salt imported and exported by non-salt-producing companies, such as some chloralkali operations and salt distributors. Reported consumption statistics are those reported only by the domestic salt producing companies.

The direct and indirect uses of salt number about 14,000 according to industry sources. The USGS annually surveys 8 major categories comprising 29 end uses. The 2003 reported percentage distribution of salt by major end use was chemicals, 40%; ice control, 37%; distributors (grocery and other wholesalers and retailers, etc.), 8%; general industrial, 6%; food processing, 4%; agricultural, 3%; primary water treatment, 2%; and other uses combined with exports, less than 1% (table 5). Distributors represented a substantial share of salt sales by the salt industry; all this salt is ultimately resold to many different end users. For a more complete analysis of end-use markets, specific sectors of distribution in table 5 can be combined, such as agricultural and water treatment with agricultural and water conditioning distribution, respectively.

Aside from the different types of salt, there are various distinctions in the packaging and applications of salt. Salt for human consumption is packaged in different sized containers for several specialized purposes. Table salt may contain 0.01% potassium iodide as an additive, which provides a source of iodine that is essential to the oxidation processes in the body. Kosher salt, sea salt, condiment salt, and salt tablets are special varieties of salt.

Animal feed and water conditioning salt are made into 22.7-kilogram (50-pound) pressed blocks. Iodine, sulfur, trace elements, and vitamins are occasionally added to salt blocks to provide nutrients not found naturally in the diet of certain livestock. Salt is also compressed into pellets that are used for water conditioning.

Chemical.—The leading consumer of salt, primarily salt brine, is the chemical industry. Salt brine is obtained from extraction of natural underground saline sources, solution-mined halite deposits (salt beds or salt domes), or the dissolution of solar salt supplies. Within this industry, the chloralkali sector remains the major consumer of salt for manufacturing chlorine, coproduct sodium hydroxide, and synthetic soda ash. Since 1986, when the last synthetic soda ash plant closed because of high production costs and competition with less expensive natural soda ash, no synthetic soda ash has been manufactured in the United States; many countries, however, still produce synthetic soda ash and use vast quantities of salt brine as feedstock.

Salt is used as the primary raw material in chlorine manufacture because it is an inexpensive and widely available source of chlorine ions. For sodium hydroxide production, salt is the main source of sodium ions. About 98% of the domestic chlorine and sodium hydroxide produced is obtained from the electrolysis of salt brine feedstock by using three-cell technologies. The types of cells and the percentages of chlorine manufactured by them are diaphragm, 78%; mercury, 14%; and membrane, 6%. The remaining 2% of chlorine and caustic soda production is recovered as a byproduct from magnesium and sodium metal manufacture. It takes about 1.75 t of salt to make 1.0 t of chlorine and 1.1 t of coproduct caustic soda. The electrolytic process ionizes the sodium chloride compound and selectively allows the ions to migrate through special membranes. Chlorine gas forms at the anode, while sodium ions bond with water molecules at the cathode to form sodium hydroxide with hydrogen gas evolving.

Chlorine and caustic soda are considered to be the first generation of products made from salt. These two chemicals are further used to manufacture other materials, which are considered to be the second generation of products from salt. Although most salt brine is produced by the same companies that use it, many chloralkali manufacturers now purchase brine from independent brine supply companies. In certain cases, brine is produced by a chemical company that uses some of it and sells the excess to neighboring competitors. According to a survey of domestic salt-based chlorine facilities, about 48% of the salt used to manufacture chlorine was captive (produced by manufacturing companies), and 31% was purchased brine. Purchased solar salt and rock salt comprised 12%, and imported rock, solar, and vacuum pan salt was 9%.

In 2003, according to the U.S. Census Bureau, 10.7 Mt of chlorine and 8.70 Mt of sodium hydroxide (caustic soda or lye) were produced. Based on the industry average ratio of 1.75 t of salt required to produce 1.0 t of chlorine and 1.1 t of coproduct sodium hydroxide, the chlorine and caustic soda industry consumed about 18.7 Mt of salt for feedstock. Reported consumption of total domestic and imported salt for chlorine manufacture was 18.8 Mt (table 5). The difference between the calculated and reported quantities was the amount of salt not reported to the USGS from imports or captive brine production of chloralkali producers.

Salt is also used as a feedstock in chemical plants that make sodium chlorate (by the electrolysis of an acidified salt brine using hydrochloric acid adjusted to a pH of 6.5), metallic sodium (by the electrolysis of a molten salt mixture containing 33.2% sodium chloride and 66.8% calcium chloride, which is added to reduce the melting temperature of salt), and other downstream chemical operations. In powdered soaps and detergents, salt is used as a bulking agent and a coagulant for colloidal dispersion after saponification. In pharmaceuticals, salt is a chemical reagent and is used as the electrolyte in saline solutions. It is used also with sulfuric acid to produce sodium sulfate and hydrochloric acid. This subsector is relatively small, representing only 5% of domestic salt sales for the entire chemical sector and only 2% of total domestic salt consumption.

The consumption of salt for metallic sodium has declined during the past several years. Since the 1970s, the number of producers has decreased from three to one; Ethyl Corp. and RMI Titanium Corp. exited the market in 1985 and 1992, respectively, leaving E.I. du Pont de Nemours & Co., Inc. as the sole manufacturer of metallic sodium in the United States. In 1998, the domestic market was less than 30,000 t, having decreased

from about 126,000 t in 1978. The phasing out of tetraethyl lead and tetramethyl lead gasoline additives was the main reason for the decline in consumption. In 1978, sodium usage in gasoline represented about 80% of the domestic market. Although there is no information about sodium consumption in 2003, the leading use of sodium in 1998 was for sodium borohydride production, which is the feedstock for sodium dithionite that is used as a reductive bleaching agent by the pulp and paper industry. Sodium for sodium borohydride manufacture accounted for about 38% of metallic sodium consumption. Sodium metal also is used to manufacture sodium azide, which is used in automotive air bags. Other promising uses of sodium metal are in the remediation of chemical weapons, chlorofluorocarbons, pesticides, and polychlorinated biphenyls.

Ice Control and Road Stabilization.—The second leading end use of salt is for highway deicing. The developer of the Fahrenheit temperature scale discovered that salt mixed with ice at a temperature below the freezing point of water creates a solution (brine) with a lower freezing point than water alone. The brine forms below the surface of the ice and snow and prevents the water from freezing into ice and bonding with the road surface, thus causing the snow and ice to melt. Salt is an inexpensive, widely available, and effective ice control agent. It does, however, become less effective as the temperature decreases below about 9° C to 6.5° C (15° F to 20° F). At lower temperatures, more salt would have to be applied to maintain higher brine concentrations to provide the same degree of melting. Most winter snowstorms and ice storms happen when temperatures are between 4° C and 0° C (25° F and 32° F), the range in which salt is most effective. An anticaking agent, such as ferric ferrocyanide (Prussian Blue) or sodium ferrocyanide (Yellow Prussiate of Soda), is used to prevent the salt from agglomerating. Both additives are nontoxic and harmless to humans. In fact, sodium ferrocyanide is approved for use in food-grade salt by the U.S. Food and Drug Administration (U.S. Food and Drug Administration, Food and Nutrition Board, 1966).

In highway deicing, salt has been associated with corrosion of bridge decks, motor vehicles, reinforcement bar and wire, and unprotected steel structures used in road construction. Surface runoff, vehicle spraying, and windblown actions also affect soil, roadside vegetation, and local surface- and ground-water supplies. Although evidence of environmental loading of salt has been found during peak usage, the spring rains and thaws usually dilute the concentrations of sodium in the area where salt was applied.

Salt also is added to stabilize the soil and to provide firmness to the foundation on which highways are built. The salt acts to minimize the effects of shifting caused in the subsurface by changes in humidity and traffic load.

The quantity of salt consumed for road deicing each year is directly related to the severity of the winter weather conditions. Long-range forecasting of salt consumption in this application is extremely difficult because of the complexities in long-range forecasting of the weather. Meteorologists, however, are becoming more aware of the dynamics of certain weather phenomena that influence the climate in various parts of the world. One of these phenomena is El Nino, an increase in sea-surface temperatures in the equatorial Pacific Ocean, is now believed to be the leading single weather influence on Earth. In the last 40 years, 10 El Ninos have been recorded. The worst was in 1997-98 which caused $33 billion in property damages around the world and killed an estimated 2,100 people worldwide. The phenomena caused above-normal temperatures, droughts, cyclones in various parts of the world, flooding, mudslides and floods in California, and storms and tornadoes along the U.S. Gulf Coast. However, in the northern part of the United States, the winters of 1997 and 1998 were so mild that heating costs were reduced by an estimated $5 billion (National Geographic, 2004§). In 1998, highway deicing salt sales were the lowest since about 1992, which also was an El Nino year (National Broadcast Company, 1998§). The winters of 1999 and 2000 were colder and produced more precipitation that required more salt for road deicing. In 2001, there was not as much cold weather and precipitation as in the winter of 2000, resulting in a 3 Mt decrease in salt consumption for highway deicing. The winter of late 2002 to early 2003 was more severe than in past years. The increase in ice storms and snowfall used more rock salt than in previous years resulting in higher salt sales by producers in 2003.

Distributors.—A tremendous amount of salt is marketed through various distributors, some of which specialize in such markets as agricultural and water treatment services, two sectors where the salt companies also have direct sales. Distributor sales also include grocery wholesalers and/or retailers, institutional wholesalers, U.S. Government resale, and other retailers and wholesalers.

General Industry.—The industrial uses of salt are diverse. They include, in descending order of quantity consumed, oil and gas exploration, other industrial applications, textiles and dyeing, metal processing, pulp and paper, tanning and leather treatment, and rubber manufacture.

In oil and gas exploration, salt is an important component of drilling fluids in well drilling. It is used to flocculate and increase the density of the drilling fluid to overcome high down-well gas pressures. Whenever a drill hits a salt formation, salt is added to the drilling fluid to saturate the solution and to minimize the dissolution within the salt stratum. Salt is also used to increase the set rate of concrete in cemented casings.

In textiles and dyeing, salt is used as a brine rinse to separate organic contaminants, to promote "salting out" of dyestuff precipitates, and to blend with concentrated dyes to standardize them. One of its main roles is to provide the positive ion charge to promote the absorption of negatively charged ions of dyes.

In metal processing, salt is used in concentrating uranium ore into uranium oxide (yellow cake). It also is used in processing aluminum, beryllium, copper, steel, and vanadium.

In the pulp and paper industry, salt is used to bleach wood pulp. It also is used to make sodium chlorate, which is added along with sulfuric acid and water to manufacture chlorine dioxide, an excellent oxygen-based bleaching chemical. The chlorine dioxide process, which originated in Germany after World War I, is becoming more popular because of environmental pressures to reduce or eliminate chlorinated bleaching compounds.

In tanning and leather treatment, salt is added to animal hides to inhibit microbial activity on the underside of the hides and to replace some of the moisture in the hides. In rubber

manufacture, salt is used to make buna, neoprene, and white types. Salt brine and sulfuric acid are used to coagulate an emulsified latex made from chlorinated butadiene.

Agricultural Industry.—Since prehistoric times, humankind has noticed that animals satisfied their salt hunger by locating salt springs, salt licks, or playa lake salt crusts. Barnyard and grazing livestock need supplementary salt rations to maintain proper nutrition. Veterinarians advocate adding loose salt in commercially mixed feeds or in block forms sold to farmers and ranchers because salt acts as an excellent carrier for trace elements not found in the vegetation consumed by grazing livestock; selenium, sulfur, and other essential elements are commonly added to salt licks, or salt blocks, for free-choice feeding.

Food Processing.—Every person uses some quantity of salt in their food. The salt is added to the food by the food processor or by the consumer as a flavor enhancer, preservative, binder, fermentation-control additive, texture-control agent, and color developer. This major category is subdivided, in descending order of salt consumption, into other food processing, meat packers, canning, baking, dairy, and grain mill products.

In meat packing, salt is added to processed meats to promote color development in bacon, ham, and other processed meat products. As a preservative, salt inhibits the growth of bacteria, which would lead to spoilage of the product. Early pioneers stored their perishable food in salt barrels for protection and preservation. Salt acts as a binder in sausages to form a binding gel made up of meat, fat, and moisture. Salt also acts as a flavor enhancer and a tenderizer.

In the dairy industry, salt is added to cheese as a color-, fermentation-, and texture-control agent. The dairy subsector includes companies that manufacture creamery butter, condensed and evaporated milk, frozen desserts, ice cream, natural and processed cheese, and specialty dairy products.

In canning, salt is primarily added as a flavor enhancer and preservative. It also is used as a carrier for other ingredients, dehydrating agent, enzyme inhibitor, and tenderizer.

In baking, salt is added to control the rate of fermentation in bread dough. It also is used to strengthen the gluten (the elastic protein-water complex in certain doughs) and as a flavor enhancer, such as a topping on baked goods.

The food-processing category also contains grain mill products, which consist of milling flour and rice and manufacturing cereal breakfast food and blended or prepared flour.

In the "other food processing" category, salt is used mainly as a seasoning agent. Other food processing includes miscellaneous establishments that make food for human consumption (such as potato chips and pretzels) and for domestic pet consumption (such as cat and dog food).

Water Treatment.—Many areas of the United States have hard water, which contains excessive calcium and magnesium ions that contribute to the buildup of a scale or film of alkaline mineral deposits in household and industrial equipment. Commercial and residential water-softening units use salt to remove the ions that cause the hardness. The sodium ions captured on a resin bed are exchanged for the calcium and magnesium ions. Periodically, the water-softening units must be recharged because the sodium ions become depleted. Salt is added and dissolved, and the brine replenishes the lost sodium ions.

Stocks

Because bulk salt is stored at many different locations, such as at the plants, ports, terminals, and warehouses, data on the quantity of salt stockpiled by the salt industry are not reliable enough to formulate accurate inventory totals; however, yearend stocks of producers were estimated to be 2 Mt, and consumer inventories also were estimated to be high. Most of these inventories were imported rock salt and solar salt. Many salt distributors, municipalities, road deicing contractors, salt producers, and States stockpiled additional quantities of salt in anticipation of adverse weather conditions. Deicing salt inventories were extremely large by yearend 2003 in anticipation of severe winter weather during late 2003 to early 2004. For the reasons discussed above, salt stocks are assumed to be the difference between salt production and salt sold or used in calculating apparent consumption.

Transportation

Because the locations of the salt supplies are not often near consumers, transportation can become an important cost. Pumping salt brine through pipelines is an economic means of transportation but cannot be used for dry salt. Large bulk shipments of dry salt in ocean freighters or river barges are low in cost but are restricted in points of origin and consumption. Lake and river movement of salt in winter is often severely curtailed because of frozen waterways. As salt is packaged, handled, and shipped in smaller units, the costs increase and are reflected in higher selling prices.

Transportation costs significantly add to the price of salt. In some cases, shipping costs are higher than the actual value of the salt. Ocean vessels can transport greater quantities of salt than barge, rail, or truck shipments. Transoceanic imports of salt have been increasing in some areas of the United States because they are more cost competitive than salt purchased from domestic suppliers using barge, rail, or truck transportation. One important factor that often determines the quantity of imported salt that can be delivered is the depth of the channels and the ports; many ports are not deep enough to accommodate the larger ships.

Prices

The four types of salt that are produced have unique production, processing, and packaging factors that determine the selling prices. Generally, salt sold in bulk is less expensive than salt that has been packaged, pelletized, or pressed into blocks. Salt in brine is the least expensive salt sold because mining and processing costs are less. Vacuum pan salt is the most expensive because of the higher energy costs involved in processing and the purity of the product.

Price quotations are not synonymous with average values reported to the USGS. The quotations do not necessarily represent prices at which transactions actually took place or bid and asked prices. Yearend prices for salt are no longer quoted in Chemical Market Reporter; this information was last available in 1997. The average annual values, as collected by the USGS

and listed in table 7, represent a national average value for each of the types of salt and the various product forms.

Foreign Trade

Under Harmonized Tariff Schedule of the United States (HTS) nomenclature, imports are aggregated under one category named "Salt (including table and denatured salt) and pure sodium chloride, whether or not in aqueous solution, seawater." The same classification also applies to exports. The HTS code for salt is 2501.00.0000. The trade tables in this report list the previous and current identification codes for salt. Although several other HTS codes pertain to various salt classifications, the United States aggregates shipments under one code because the sums of individual subclassifications fail to meet the minimum dollar requirements necessary for individual listings.

Based on U.S. Census Bureau data for 2003, the United States exported 718,000 t; this was a 4% increase compared with that of 2002 (table 8). Salt was shipped to 75 countries through 32 customs districts; the Cleveland, OH, district exported the most and represented 22% of the U.S. total (table 9). In 2003, the majority of exports (81%) was to Canada.

Based on U.S. Census Bureau statistics, the United States imported 12.9 Mt of salt from 46 countries in 2003, which was 58% more than was imported during 2002 (table 10). Table 11 lists the imports of salt by customs districts. Of the 39 customs districts that imported salt in 2003, the New York, NY, customs district was the leading in terms of tonnage accounting for about 21% of the total. Canada was the leading source of imports, representing about 32% of total imports. The quantity of imported salt was about 18 times more than that of exports. This indicates the magnitude of the United States' reliance on salt imports. The majority of imported salt was brought into the country by foreign subsidiaries of major U.S. salt producers. Generally, imported salt can be purchased and delivered to many customers at prices lower than the comparable domestic product because production costs are lower abroad, currency exchange rates are more favorable, and ocean freight rates are less expensive than overland rail or truck rates.

World Review

Table 12 lists world salt production statistics for 115 nations based on reported and estimated information. In 2003, the total estimated world production increased to about 210 Mt. The United States remained the world's leading salt-producing country, representing 21% of total world output.

Most countries possess some form of salt production capability with production levels set to meet their own domestic demand requirements and with additional quantities available for export. Many developing nations tend to develop their agricultural resources to feed their population first. Development of easily extractable mineral resources follows, and salt is one of the first commodities to be mined. Some countries, such as the United States, import a substantial amount of salt to meet total demand requirements because of economic factors.

Outlook

Although the severity of winter weather is virtually impossible to forecast far in advance, the supplies of salt, from either domestic or imported sources, are more than adequate to meet any anticipated increase in demand. The El Nino of 1997-98 was the first time that climate scientists were able to predict abnormal flooding and droughts months in advance. As of August 2004, there were signs that indicated that another El Nino was likely for 2004-05 (Washington Post, 2004). If this forecast is accurate, the winter should be mild for late 2004 through early 2005 resulting in less road salt consumed.

The outlook for balancing salt supplies (from domestic production and imports) with salt demand is very favorable for the foreseeable future. Excluding deicing salt, domestic salt consumption may fluctuate but should continue to grow parallel to population growth trends. Total U.S. salt production in 2004 is expected to be 41 Mt.

References Cited

Industrial Minerals, 2003, IMC sells Compass Minerals stake and SOP business: Industrial Minerals, no. 431, May 2003, p. 22.

U.S. Food and Drug Administration, Food and Nutrition Board, 1966, Sodium chloride, *in* Food chemicals codex: Washington, DC, National Academy of Sciences, p. 613-614.

Washington Post, The, 2004, Warmer Pacific waters may signal El Nino: The Washington Post, August 6, p. A9.

Internet References Cited

Compass Minerals International, 2003 (November 5), Salt Holdings Corporation changes its name to Compass Minerals International, Inc. and announces the filing of a registration statement for an initial public offering, News Release, accessed October 4, 2004, at URL http://www.compassminerals.com/press_releases/11052003.htm.

National Broadcast Company, 1998, El Nino facts, accessed July 15, 1998, at URL http://wxnet4.nbcr.com/elnino.html.

National Geographic Magazine, 2004, El Nino/La Nina—Nature's vicious cycle, accessed March 17, 2004, at URL http://www.nationalgeographic.com/elnino/mainpage.html.

GENERAL SOURCES OF INFORMATION

U.S. Geological Survey Publications

Evaporites and Brines. Ch. in United States Mineral Resources, Professional Paper 820, 1973.

Salt. Ch. in Mineral Commodity Summaries, annual.

Other

Chlorine Institute, The.

Lefond, S. J., 1969, Handbook of world salt resources: New York, NY, Plenum Press, 384 p.

Material Flow of Salt, The, U.S. Bureau of Mines Information Circular 9343, 1993.

Salt. Ch. in Canadian Minerals Yearbook, annual.

Salt. Ch. in Industrial Minerals and Rocks (6th ed.), Carr, D.D., ed., Society for Mining, Metallurgy, and Exploration, Inc., 1994.

Salt. Ch. in Mineral Facts and Problems, U.S. Bureau of Mines Bulletin 675, 1985.
Salt Institute.
Salt. Mining Engineering, annual review of industrial minerals.
Sodium Chloride. American Chemical Society Monograph No. 145, 1960.
Solution Mining Research Institute.

TABLE 1
SALIENT SALT STATISTICS[1]

(Thousand metric tons and thousand dollars)

	1999	2000	2001	2002	2003
United States:					
Production:[2]					
Brine	22,700	22,500	20,400	19,300	20,000
Rock	14,400	15,000	17,000	13,500	16,300
Solar	3,580	3,810	3,310	3,390	3,330
Vacuum and open pans	4,190	4,200	4,120	4,100	4,070
Total	44,900	45,600	44,800	40,300	43,700
Sold or used by producers:					
Quantity	44,400	43,300	42,200	37,700	41,100
Value	$1,110,000	$1,040,000	$1,110,000	$1,010,000	$1,130,000
Exports:					
Quantity	892	642	1,120	689	718
Value	$37,000	$37,800	$48,000	$31,600	$37,500
Imports for consumption:					
Quantity	8,870	8,960	12,900	8,160	12,900
Value	$137,000	$127,000	$179,000	$129,000	$196,000
Consumption:					
Apparent[3]	52,400	51,600	54,000	45,100	53,200
Reported	50,000	54,000	48,700	43,600	50,200
World, production	207,000 r	209,000 r	214,000 r	208,000 r	210,000 e

eEstimated. rRevised.
[1]Data are rounded to no more than three significant digits.
[2]Excludes Puerto Rico.
[3]Sold or used plus imports minus exports.

TABLE 2
SALT PRODUCED IN THE UNITED STATES, BY TYPE AND PRODUCT FORM[1]

(Thousand metric tons)

Product form	Vacuum and open pans	Solar	Rock	Brine	Total
2002:					
Bulk	770	2,080	13,200	19,300	35,300
Compressed pellets	1,290	383	XX	XX	1,670
Packaged	1,850	793	293	XX	2,940
Pressed blocks	183	135	68	XX	386
Total	4,100	3,390	13,500	19,300	40,300
2003:					
Bulk	737	1,990	15,800	20,000	38,500
Compressed pellets	1,290	389	XX	XX	1,680
Packaged	1,870	810	414	XX	3,100
Pressed blocks	171	136	78	XX	384
Total	4,070	3,330	16,300	20,000	43,700

XX Not applicable.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.

TABLE 3
SALT SOLD OR USED IN THE UNITED STATES, BY TYPE AND PRODUCT FORM[1, 2]

(Thousand metric tons and thousand dollars)

	Vacuum and open pans		Solar		Rock		Brine		Total	
Product form	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
2002:										
Bulk	759	44,100	1,460	34,500	11,000	221,000	19,300	114,000	32,500	413,000
Compressed pellets	1,280	173,000	353	41,600	XX	XX	XX	XX	1,640	214,000
Packaged:										
Less-than-5-pound units	224	NA	12	NA	1	NA	XX	XX	237	XX
More-than-5-pound units	1,620	NA	952	NA	342	NA	XX	XX	2,910	XX
Total	1,840	249,000	964	73,400	343	24,200	XX	XX	3,150	347,000
Pressed blocks:										
For livestock	116	NA	115	NA	77	NA	XX	XX	308	XX
For water treatment	69	NA	6	NA	5	NA	XX	XX	81	XX
Total	185	19,900	121	11,800	82	8,380	XX	XX	389	40,100
Grand total	4,070	486,000	2,890	161,000	11,400	254,000	19,300	114,000	37,700	1,010,000
2003:										
Bulk	736	44,400	1,440	35,100	13,600	291,000	20,000	144,000	35,800	515,000
Compressed pellets	1,310	177,000	372	44,100	XX	XX	XX	XX	1,680	222,000
Packaged:										
Less-than-5-pound units	221	NA	13	NA	(3)	NA	XX	XX	234	XX
More-than-5-pound units	1,570	NA	967	NA	455	NA	XX	XX	2,990	XX
Total	1,790	255,000	981	70,100	455	33,200	XX	XX	3,230	358,000
Pressed blocks:										
For livestock	107	NA	98	NA	86	NA	XX	XX	291	XX
For water treatment	65	NA	23	NA	6	NA	XX	XX	93	XX
Total	171	18,100	121	12,100	92	9,310	XX	XX	385	39,500
Grand total	4,010	495,000	2,910	161,000	14,100	334,000	20,000	144,000	41,100	1,130,000

NA Not available. XX Not applicable.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]As reported at salt production locations, the term "sold or used" indicates that some salt, usually salt brine, is not sold but is used for captive purposes by plant or company. Because data do not include salt imported, purchased, and/or sold from inventory from regional distribution centers, salt sold or used by type may differ from totals shown in tables 5 and 6, which are derived from company totals.

[3]Less than 1/2 unit.

TABLE 4
SALT SOLD OR USED BY PRODUCERS IN THE UNITED STATES, BY STATE[1, 2]

(Thousand metric tons and thousand dollars)

	2002		2003	
State	Quantity	Value	Quantity	Value
Kansas	2,630	119,000	2,770	123,000
Louisiana	12,000	129,000	12,600	152,000
New York	4,610	185,000	5,230	225,000
Texas	9,100	103,000	9,640	116,000
Utah	2,090	113,000	2,200	119,000
Other Eastern States[3]	6,120	299,000	7,510	336,000
Other Western States[4]	1,100	66,900	1,140	63,800
Total	37,700	1,010,000	41,100	1,130,000
Puerto Rico[e]	45	1,500	45	1,500

[e]Estimated.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]The term "sold or used" indicates that some salt, usually salt brine, is not sold but is used for captive purposes by plant or company.

[3]Includes Alabama, Michigan, Ohio, Tennessee, and West Virginia.

[4]Includes Arizona, California, Nevada, New Mexico, and Oklahoma.

TABLE 5
DISTRIBUTION OF DOMESTIC AND IMPORTED SALT BY PRODUCERS IN THE UNITED STATES BY END USE AND TYPE[1, 2]

(Thousand metric tons)

End use	Standard industrial classification	Vacuum and open pans		Solar		Rock		Brine		Total[3]	
		2002	2003	2002	2003	2002	2003	2002	2003	2002	2003
Chemical:											
Chloralkali producers	2812	23	21	324	326	634	637	17,400	17,800	18,300	18,800
Other chemical	28 (excludes 2812, 2899)	240	231	172	217	716	808	2	2	1,130	1,260
Total		263	253	496	542	1,350	1,440	17,400	17,800	19,500	20,100
Food-processing industry:											
Meat packers	201	262	247	56	46	76	80	(4)	--	395	374
Dairy	202	125	122	8	10	3	4	--	1	136	136
Canning	2091, 203	143	154	43	39	42	37	1	--	230	231
Baking	205	197	193	5	5	13	12	--	--	215	210
Grain mill products	204 (excludes 2047)	89	91	8	10	23	17	--	--	120	117
Other food processing	206-208, 2047, 2099	537	545	70	74	82	99	1	1	690	719
Total		1,350	1,350	190	184	239	249	2	2	1,780	1,790
General industrial:											
Textiles and dyeing	22	105	104	38	38	11	9	(4)	(4)	154	151
Metal processing	33, 34, 35, 37	7	14	27	24	84	88	--	(4)	118	126
Rubber	2822, 30 (excludes 3079)	3	3	1	1	1	1	56	62	61	67
Oil	13, 29	34	24	100	147	54	44	1,820	2,000	2,010	2,210
Pulp and paper	26	11	10	45	44	21	17	16	18	93	88
Tanning and/or leather	311	18	11	20	20	41	39	--	--	79	71
Other industrial	XX	117	115	81	108	80	110	1	(4)	279	333
Total		294	282	312	379	293	310	1,890	2,080	2,790	3,050
Agricultural:											
Feed retailers and/or dealers mixers	5159	330	313	330	346	381	430	--	--	1,040	1,090
Feed manufactuers	2048	55	45	130	124	322	290	--	--	507	460
Direct-buying end user	02	5	5	14	13	51	46	--	--	70	65
Total		390	364	474	483	753	767	--	--	1,620	1,610
Water treatment:											
Government (Federal, State, local)	2899	17	17	95	103	123	127	3	3	238	251
Commercial or other	2899	130	149	163	197	128	178	2	2	424	526
Total		147	166	258	301	252	305	5	6	662	777
Ice control and/or stabilization:											
Government (Federal, State, local)	9621	2	1	708	958	10,800	15,200	--	--	11,600	16,200
Commercial or other	XX	2	5	146	271	1,590	2,040	--	--	1,730	2,320
Total		4	6	854	1,230	12,400	17,200	--	--	13,300	18,500
Distributors:											
Agricultural distribution	5191	88	66	111	99	46	50	--	--	245	215
Grocery wholesalers and/or retailers	514, 54	515	529	220	213	45	61	--	--	781	802
Institutional wholesalers and end users	58, 70	106	103	49	56	32	51	(4)	(4)	187	210
Water-conditioning distribution	7399	123	122	385	387	16	26	1	1	525	537
U.S. Government resale	9199	(4)	(4)	(4)	(4)	1	1	--	--	1	1
Other wholesalers and/or retailers	5251	849	866	847	872	231	424	(4)	(4)	1,930	2,160
Total		1,680	1,690	1,610	1,630	371	614	2	1	3,670	3,930
Other[5]		110	100	52	48	67	277	110	21	339	446
Grand total		4,240	4,210	4,250	4,790	15,800	21,200	19,400	20,000	43,600	50,200

XX Not applicable. -- Zero.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]The quality of imports included in the total for each type of salt is the amount reported by the U.S. salt industry, not the quantity reported by the U.S. Census Bureau that appears in tables 1, 11, and 12.

[3]Because data include salt imported, produced, and/or sold from inventory from regional distribution centers, data for salt sold or used by type may differ from totals shown in tables 1, 3, and 4, which are derived from plant reports at salt production locations. Data may differ from totals shown in table 6 because of changes in inventory and/or incomplete data reporting.

[4]Less than 1/2 unit.

[5]Includes exports.

TABLE 6
DISTRIBUTION OF DOMESTIC AND IMPORTED EVAPORATED AND ROCK SALT IN THE UNITED STATES, BY DESTINATION[1, 2]

(Thousand metric tons)

	2002				2003			
	Evaporated				Evaporated			
Destination	Vacuum and open pans	Solar	Rock	Total	Vacuum and open pans	Solar	Rock	Total
Alabama	72	2	71	144	67	2	80	150
Alaska	4	3	(3)	7	5	3	(3)	8
Arizona	13	95	8	116	13	97	2	112
Arkansas	44	2	54	100	45	2	57	105
California	216	584	2	802	211	649	3	863
Colorado	13	79	85	177	12	76	130	218
Connecticut	17	88	114	219	16	82	119	216
Delaware	4	9	1	15	4	10	1	16
District of Columbia	1	7	(3)	8	1	34	0	35
Florida	81	208	6	294	83	246	6	335
Georgia	79	59	57	195	79	51	51	181
Hawaii	(3)	1	(3)	2	(3)	1	--	2
Idaho	17	114	1	133	18	97	(3)	115
Illinois	355	111	1,480	1,950	347	123	1,810	2,280
Indiana	249	114	588	952	260	127	1,050	1,440
Iowa	142	100	461	703	136	92	518	747
Kansas	95	44	234	374	91	44	273	409
Kentucky	66	7	525	598	64	6	790	859
Louisiana	62	2	562	626	57	2	517	575
Maine	13	14	228	255	14	4	231	249
Maryland	65	70	12	147	62	147	19	228
Massachusetts	32	187	162	382	30	269	210	509
Michigan	290	39	1,770	2,100	280	44	2,510	2,840
Minnesota	134	227	504	865	141	160	609	910
Mississippi	26	(3)	249	275	28	1	246	274
Missouri	147	57	386	590	146	63	614	823
Montana	1	32	1	34	1	24	1	26
Nebraska	73	44	151	269	62	44	177	282
Nevada	5	275	14	294	5	288	(3)	293
New Hampshire	16	85	42	142	15	91	57	163
New Jersey	117	71	36	225	116	208	138	461
New Mexico	14	71	3	88	16	55	1	72
New York	196	59	2,050	2,300	188	42	2,410	2,640
North Carolina	110	76	43	229	112	68	80	260
North Dakota	4	17	5	25	4	14	5	23
Ohio	412	46	1,790	2,250	412	100	3,190	3,710
Oklahoma	36	20	57	113	36	22	50	108
Oregon	19	104	1	124	17	102	1	120
Pennsylvania	170	92	1,520	1,780	183	112	1,930	2,230
Rhode Island	4	69	48	121	4	238	105	347
South Carolina	34	17	6	57	36	6	5	47
South Dakota	20	46	32	97	20	43	47	109
Tennessee	96	26	481	603	101	18	542	661
Texas	222	137	193	552	223	144	180	548
Utah	14	350	64	428	13	272	160	445
Vermont	6	5	380	391	7	5	391	403
Virginia	66	84	55	204	70	187	109	366
Washington	24	108	8	140	27	89	3	119
West Virginia	12	5	131	148	12	5	264	281
Wisconsin	213	140	1,010	1,370	208	130	1,240	1,580
Wyoming	(3)	21	6	27	(3)	20	2	23
Other[4]	123	25	66	214	107	32	268	408
Total[5]	4,240	4,250	15,800	24,200	4,210	4,790	21,200	30,200

See footnotes at end of table.

TABLE 6--Continued
DISTRIBUTION OF DOMESTIC AND IMPORTED EVAPORATED AND ROCK SALT IN THE UNITED STATES, BY DESTINATION[1, 2]

-- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Each salt type includes domestic and imported quantities. Brine is excluded because brine is not shipped out of State.
[3]Less than 1/2 unit.
[4]Includes shipments to overseas areas administered by the United States, Puerto Rico, exports, and some shipments to unspecified destinations.
[5]Because data include salt imported, purchased, and/or sold from inventory from regional distribution centers, data for evaporated and rock salt distributed by State may differ from totals shown in tables 1 and 3, which are derived from plant reports at salt production locations. Data may differ from totals shown in table 5 because of changes in inventory and/or incomplete data reporting.

TABLE 7
AVERAGE VALUE OF SALT, BY PRODUCT FORM AND TYPE[1]

(Dollars per metric ton)

Product form	Vacuum and open pans	Solar	Rock	Brine
2002:				
Bulk	58.12	23.73	20.10	5.89
Compressed pellets	134.61	117.62	XX	XX
Packaged	135.39	76.17	70.62	XX
Average[2]	120.02	53.93	21.62	5.89
Pressed blocks	107.18	98.14	101.81	XX
2003:				
Bulk	60.41	24.35	21.44	7.21
Compressed pellets	135.59	118.47	XX	XX
Packaged	142.17	71.44	73.00	XX
Average[2]	124.24	53.42	23.11	7.21
Pressed blocks	105.81	99.32	101.42	XX

XX Not applicable.
[1]Net selling value, free on board plant, excluding container costs.
[2]Salt value data reported prior to 1984 were an aggregate value per metric ton of bulk, compressed pellets, and packaged salt. For time series continuity, an average of these three types of product forms is presented that is based on the aggregated values and quantities of the product form for each type of salt listed in table 3.

TABLE 8
U.S. EXPORTS OF SALT, BY COUNTRY[1]

(Thousand metric tons and thousand dollars)

Country	2002		2003	
	Quantity	Value[2]	Quantity	Value[2]
Argentina	(3)	48	3	169
Bahamas, The	1	208	1	231
Bahrain	1	214	1	276
Belgium	(3)	33	2	368
Canada	585	21,000	585	23,700
Chile	1	210	1	158
China	(3)	91	4	299
Colombia	1	147	(3)	100
Costa Rica	1	140	1	183
Dominican Republic	1	130	2	182
El Salvador	1	163	1	205
Honduras	5	613	8	874

See footnotes at end of table.

TABLE 8--Continued
U.S. EXPORTS OF SALT, BY COUNTRY[1]

(Thousand metric tons and thousand dollars)

Country	2002		2003	
	Quantity	Value[2]	Quantity	Value[2]
Hong Kong	1	173	(3)	188
Israel	(3)	37	1	50
Italy	(3)	24	1	78
Jamaica	2	141	(3)	31
Japan	2	550	3	784
Korea, Republic of	(3)	128	1	144
Kuwait	(3)	41	1	165
Lebanon	1	143	(3)	153
Malaysia	4	147	3	135
Mexico	59	2,880	78	4,480
Netherlands	(3)	35	1	114
Panama	3	430	1	191
Saudi Arabia	12	1,560	12	1,360
Trinidad and Tobago	1	25	(3)	6
United Arab Emirates	1	445	1	380
United Kingdom	2	548	4	963
Other	4	1,310 r	4	1,480
Total	689	31,600	718	37,500

rRevised.
[1]Data are rounded to no more than three significant digits; may not add to totals shown. (The Harmonized Tariff Schedule of the United States code for salt is 2501.00.0000.)
[2]Free alongside ship value at U.S. ports.
[3]Less than 1/2 unit.

Source: U.S. Census Bureau.

TABLE 9
U.S. EXPORTS OF SALT, BY CUSTOMS DISTRICT[1]

(Thousand metric tons and thousand dollars)

District	2002		2003	
	Quantity	Value[2]	Quantity	Value[2]
Anchorage, AK	--	--	2	96
Baltimore, MD	3	518	7	905
Boston, MA	--	--	8	265
Buffalo, NY	24	2,040	113	4,070
Charleston, SC	(3)	24	(3)	62
Chicago, IL	108	2,100	18	595
Cleveland, OH	196	3,660	157	3,820
Dallas-Fort Worth, TX	(3)	14	(3)	31
Detroit, MI	25	2,720	131	5,730
Duluth, MN	(3)	8	--	--
El Paso, TX	10	413	7	470
Great Falls, MT	10	411	9	494
Houston, TX	16	2,570	11	2,140
Laredo, TX	41	1,760	64	3,430
Los Angeles, CA	7	910	8	1,060
Miami, FL	4	692	4	717
Mobile, AL	1	128	4	443
New Orleans, LA	5	479	3	411
New York, NY	7	1,160	10	1,530
Nogales, AZ	6	321	2	123
Norfolk, VA	1	357	1	212
Ogdensburg, NY	30	961	29	1,680

See footnotes at end of table.

TABLE 9--Continued
U.S. EXPORTS OF SALT, BY CUSTOMS DISTRICT[1]

(Thousand metric tons and thousand dollars)

District	2002		2003	
	Quantity	Value[2]	Quantity	Value[2]
Pembina, ND	3	363	4	394
Philadelphia, PA	(3)	117	(3)	65
Port Arthur, TX	(3)	24	--	--
Portland, ME	3	188	1	60
St. Albans, VT	(3)	13	(3)	35
St. Louis, MO	(3)	154	--	--
San Diego, CA	3	390	5	481
San Francisco, CA	1	230	5	579
Savannah, GA	(3)	39	(3)	52
Seattle, WA	9	616	11	712
Tampa, FL	(3)	24	(3)	75
Wilmington, NC	(3)	5	(3)	5
Other[4]	178	8,230	105	6,740
Total	691	31,600	718	37,500

-- Zero.

[1]Data are rounded to no more than three significant digits; may not add to totals shown. (The Harmonized Tariff Schedule of the United States code for salt is 2501.00.0000.)

[2]Free alongside ship value at U.S. ports.

[3]Less than 1/2 unit.

[4]Unknown but assumed to be rail and/or truck shipments to Canada through various points of departure.

Source: U.S. Census Bureau.

TABLE 10
U.S. IMPORTS FOR CONSUMPTION OF SALT, BY COUNTRY[1]

(Thousand metric tons and thousand dollars)

Country	2002		2003	
	Quantity	Value[2]	Quantity	Value[2]
Australia	125	1,080	192	1,740
Bahamas, The	499	6,880	1,140	12,500
Belgium	(3)	126	1	110
Brazil	92	1,260	125	1,470
Canada	3,660	60,800	4,190	89,200
Chile	1,990	24,700	3,920	38,500
China	2	920	3	896
Colombia	(3)	33	1	131
Egypt	107	870	555	4,450
France	22	2,600	17	3,650
Germany	1	739	1	794
Iceland	--	--	1	130
India	(3)	13	33	314
Ireland	25	201	108	1,130
Israel	1	484	1	607
Italy	4	771	70	1,460
Jordan	218	1,720	8	517
Korea, Republic of	1	478	1	525
Mexico	738	13,600	1,190	18,000
Nambia	--	--	39	711
Netherlands	144	4,640	147	5,140
Netherlands Antilles	124	2,360	336	5,660
Pakistan	(3)	28	2	132
Panama	--	--	57	672

See footnotes at end of table.

TABLE 10--Continued
U.S. IMPORTS FOR CONSUMPTION OF SALT, BY COUNTRY[1]

(Thousand metric tons and thousand dollars)

Country	2002		2003	
	Quantity	Value[2]	Quantity	Value[2]
Peru	347	2,510	454	3,290
Portugal	1	74	(3)	76
South Africa	(3)	19	3	164
Spain	(3)	148	7	440
Tunisia	35	803	34	863
United Kingdom	11	354	88	831
Venezuela	--	--	132	1,100
Other	1 r	535 r	1	433
Total	8,160	129,000	12,900	196,000

rRevised. -- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown. (The Harmonized Tariff Schedule of the United States code for salt is 2501.00.0000.)
[2]Customs value only.
[3]Less than 1/2 unit.

Source: U.S. Census Bureau.

TABLE 11
U.S. IMPORTS OF SALT, BY CUSTOMS DISTRICT[1]

(Thousand metric tons and thousand dollars)

District	2002		2003	
	Quantity	Value[2]	Quantity	Value[2]
Anchorage, AK	3	118	20	502
Baltimore, MD	668	9,840	1,100	14,500
Boston, MA	568	5,600	1,250	12,100
Buffalo, NY	204	4,390	288	9,270
Charleston, SC	150	4,470	166	4,040
Chicago, IL	488	7,460	759	11,900
Cleveland, OH	388	6,640	473	9,350
Columbia-Snake, OR	(3)	91	2	149
Dallas-Fort Worth, TX	(3)	34	(3)	16
Detroit, MI	1,200	19,600	1,400	30,800
Duluth, MN	112	1,410	110	2,100
El Paso, TX	(3)	3	(3)	3
Great Falls, MT	2	338	3	314
Honolulu, HI	--	--	(3)	8
Houston-Galveston, TX	1	394	1	567
Laredo, TX	2	340	1	289
Los Angeles, CA	109	2,660	113	2,900
Miami, FL	(3)	171	(3)	131
Milwaukee, WI	878	15,300	841	18,600
Minneapolis, MN	(3)	9	(3)	12
Mobile, AL	(3)	25	--	--
New Orleans, LA	109	1,210	319	3,640
New York, NY	1,080	16,100	2,720	31,300
Nogales, AZ	(3)	42	--	--
Norfolk, VA	121	1,740	243	2,620
Ogdensburg, NY	99	1,810	154	3,670
Pembina, ND	1	601	1	481
Philadelphia, PA	487	7,260	876	9,630
Portland, ME	778	8,440	1,130	11,000
Providence, RI	298	5,310	510	8,160
St. Albans, VT	2	223	6	726

See footnotes at end of table.

TABLE 11--Continued
U.S. IMPORTS OF SALT, BY CUSTOMS DISTRICT[1]

(Thousand metric tons and thousand dollars)

District	2002		2003	
	Quantity	Value[2]	Quantity	Value[2]
St. Louis, MO	(3)	32	(3)	21
San Diego, CA	(3)	59	(3)	38
San Francisco, CA	(3)	131	1	548
San Juan, PR	4	93	1	153
Savannah, GA	47	697	47	801
Seattle, WA	15	816	(3)	339
Tampa, FL	265	4,130	280	4,500
Wilmington, NC	79	1,240	36	441
Total	8,160	129,000	12,900	196,000

-- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown. (The Harmonized Tariff Schedule of the United States code for salt is 2501.00.0000.)
[2]Customs value only.
[3]Less than 1/2 unit.

Source: U.S. Census Bureau.

TABLE 12
SALT: WORLD PRODUCTION, BY COUNTRY[1, 2]

(Thousand metric tons)

Country[3]	1999	2000	2001	2002	2003[e]
Afghanistan, rock salt[e]	13	13	13	13	13
Albania[e]	10	10	10	10	10
Algeria, brine and sea salt	164	182 [e]	185 [r]	205 [r]	191 [4]
Angola[e]	30	30	30	30	30
Argentina	1,263	1,000 [e]	1,270 [r]	1,080 [r]	1,156 [4]
Armenia	27	30	30 [e]	30 [e]	30
Australia, salt and marine salt	9,888	8,778	9,536	9,887	9,800
Austria:[e]					
Brine salt	400	400	400	400	400
Rock salt	1	1	1	1	1
Total	401	401	401	401	401
Azerbaijan	3	4	4 [e]	4 [e]	4
Bahamas, The[e]	900	900	900	900	900
Bangladesh, marine salt[e, 5]	350	350	350	350	350
Belarus	344	311	300 [e]	300 [e]	300
Benin, marine salt[e]	15	15	15	15	15
Bolivia	1	(6)	(6)	4 [r]	3
Bosnia and Herzegovina[e]	50	50	50	50	50
Botswana[7]	233	185	179	315 [r]	320
Brazil:					
Brine salt	4,528	4,626	4,370	4,835 [r]	4,800
Rock salt	1,430	1,448	1,208	1,274 [r]	1,300
Total	5,958	6,074	5,578	6,109 [r]	6,100
Bulgaria[e]	1,300	1,700	1,931 [4]	1,800 [r]	1,800
Burkina Faso[e]	5 [r]	5 [r]	5 [r]	5 [r]	5
Burma[e, 8]	35	35	35	35	35
Cambodia[e]	40	40	40	40	40
Canada	12,686	12,164	13,725	12,313	13,350 [4]
Cape Verde[e]	2	2	2	2	2
Chile	6,074	5,083	5,989	3,503 [r]	4,000
China	28,124	31,280	34,105	36,024 [r]	32,424 [4]

See footnotes at end of table.

TABLE 12--Continued
SALT: WORLD PRODUCTION, BY COUNTRY[1, 2]

(Thousand metric tons)

Country[3]	1999	2000	2001	2002	2003
Colombia:					
Marine salt	157	178	110	120 e	120
Rock salt	304	282	285	300 e	300
Total	461	460	395	420 e	420
Costa Rica, marine salt[e]	37	37	37	37	37
Croatia	18	34	33	37	37
Cuba	159	177	180	180 e	180
Denmark, sales[e]	600	605	600 r	600 r	605
Djibouti	127	136	173	162 r	163
Dominican Republic:					
Marine salt[e]	50	50	50	50	50
Rock salt	305 r	196 r	312 r	20 r	2 [4]
Total	355 r	246 r	362 r	70 r	52
Ecuador[e]	95	90	90	90	90
Egypt[e]	2,400	2,400	2,400	2,400	2,400
El Salvador, marine salt	7 r	7 r	7 r	7 r	7
Eritirea, marine salt	10	47	78 r	116 r	117
Ethiopia, rock salt[e, 5]	56 [4]	56	61	61	61
France:[e]					
Brine salt	1,500	1,500	1,500	1,500	1,500
Marine salt	1,200	1,200	1,200	1,200	1,200
Rock salt	300	300	300	300	300
Salt in solution	4,000	4,000	4,000	4,000	4,000
Total	7,000	7,000	7,000	7,000	7,000
Georgia[e]	27	30	30	30	30
Germany:[e]					
Marine salt	700	700	700	700	700
Rock salt and other	15,000	15,000	15,000	15,000	15,000
Total	15,700	15,700	15,700	15,700	15,700
Ghana[e]	125	150	68 r	99 r	100
Greece[e]	150	150	150	150	150
Guadeloupe[e]	50	49	49	49	49
Guatemala[e]	50	50	50	50	60
Guinea[e]	15	15	15	15	15
Honduras[e]	25	25	25	25	26
Iceland[e]	4	4	5	5	5
India:					
Marine salt	14,450	14,450	14,500 e	14,500 e	15,000
Rock salt and other	3	3	3	3	3
Total	14,453	14,453	14,503	14,503	15,003 [4]
Indonesia[e]	680	680	680	680	680
Iran[e, 9]	1,600 [4]	1,560 r	1,985 r	1,970 r, e	1,970
Iraq[e]	300	300	300	203 r, 4	50
Israel	538	526	537 e	580 r, e	563
Italy:[e]					
Brine and rock salt	3,000	3,000	3,000	3,000	3,000
Marine salt, crude [10]	600	600	600	600	600
Total	3,600	3,600	3,600	3,600	3,600
Jamaica	19	19	19	19 r, e	19
Japan	1,327	1,374	1,358	1,282 r	1,263 [4]
Jordan	279	311	321 e	347 e	339
Kenya, crude salt	45	16	6	19 r	19
Korea, North[e]	500	500	500	500	500
Korea, Republic of[e]	800	800	800	800	800
Kuwait[e]	100	100	100	100	100
Laos, rock salt	2	2	3 r	5 r	5
Lebanon[e]	4	4	4	4	4
Libya[e]	30	40	40	40	40
Madagascar	26	26	26	17 r, e	23
Mali[e]	6	6	6	6	6

See footnotes at end of table.

TABLE 12--Continued
SALT: WORLD PRODUCTION, BY COUNTRY[1, 2]

(Thousand metric tons)

Country[3]	1999	2000	2001	2002	2003[e]
Malta, marine salt[e]	(6)	(6)	(6)	(6)	(6)
Martinique[e]	200	200	200	200	200
Mauritania[e]	6	6	6	6	6
Mauritius	7	6	6 [e]	6 [e]	6
Mexico	8,236	8,884	8,501	7,802 [r]	8,000
Mongolia, mine output	2	1	2	1	1
Morocco, marine and rock salt[e]	196	188	234 [r]	266 [r]	236 [4]
Mozambique, marine salt[e]	82	7	10	80	80
Namibia, marine salt	503	523 [r]	543 [r]	630 [r]	698 [4]
Nepal[e, 11]	1	2 [4]	5 [r]	5 [r]	5
Netherlands[e]	5,000	5,000	5,000	5,000	5,000
Netherlands Antilles[e]	500	500	500	500	500
New Zealand[e]	65	60	70	70	70
Nicaragua, marine salt	27	16 [r]	18 [r]	23 [r]	20
Niger[e]	2	2	2	2	2
Oman	NA	12	14	14	15
Pakistan:[5]					
Marine salt[e]	16 [4]	20	20	20	20
Rock salt	1,019	1,313	1,300 [e]	1,300 [e]	1,300
Total	1,035	1,333	1,320 [e]	1,320 [e]	1,320
Panama, marine salt[e]	23	23	23	23	23
Peru[e]	80	80	80	80	80
Philippines, marine salt	704	590	600 [e]	600 [e]	600
Poland:					
Rock salt	923	841	787	839 [r]	800
Recovered from brine	700 [r]	735 [r]	697 [r]	727 [r]	700
Total	1,623 [r]	1,576 [r]	1,484 [r]	1,566 [r]	1,500
Portugal, rock salt[e]	600	600	600	600	600
Romania:					
Rock salt	64	52	48	46 [r, e]	50
Other	2,133	2,215	2,176	2,211 [r]	2,200
Total	2,197	2,267	2,224	2,257 [r]	2,250
Russia	3,200	3,200 [e]	2,800	2,800 [e]	2,800
Saudi Arabia	200	200	200	200 [e]	200
Senegal[e]	130 [4]	130 [4]	130	130	130
Serbia and Montenegro	64	78	62	42	43
Slovakia[e]	100	99	100	100	100
Slovenia[e]	5	2	2	2	2
Somalia[e]	1	1	1	1	1
South Africa	358	346	356	431	438 [4]
Spain:[e]					
Marine and other evaporated salt	1,200	1,200	1,200	1,200	1,200
Rock salt	2,000	2,000	2,000	2,000	2,000
Total	3,200	3,200	3,200	3,200	3,200
Sri Lanka	107	70	130	74 [r]	75
Sudan	117	87 [r]	78 [r]	83 [r]	84
Switzerland[e]	300	300	300	300	300
Syria	104	106	190 [r]	146 [r]	146
Taiwan, marine salt	77	70	66	57	(6) [4]
Tanzania	36	70	65	66 [r]	77
Thailand:					
Rock salt	740	792	853	909 [r]	900
Other[e]	100	100	100	100	100
Total	840	892	953	1,009 [r]	1,000
Tunisia, marine salt	447 [e]	620	654 [r]	616	700
Turkey	2,146	2,126	1,771 [r]	2,197 [r]	2,200
Turkmenistan[e]	215	215	215	215	215
Uganda[e]	5	5	5	5	5
Ukraine	2,185	2,287	2,300 [e]	2,300 [e]	2,300

See footnotes at end of table.

TABLE 12--Continued
SALT: WORLD PRODUCTION, BY COUNTRY[1, 2]

(Thousand metric tons)

Country[3]	1999	2000	2001	2002	2003[e]
United Kingdom:[e]					
Brine salt[12]	1,300	1,300	1,300	1,300	1,300
Rock salt	1,500	1,500	1,500	1,500	1,500
Other salt[12]	3,000	3,000	3,000	3,000	3,000
Total	5,800	5,800	5,800	5,800	5,800
United States, including Puerto Rico:					
United States:					
Brine	22,700	22,500	20,400	19,300	20,000 [4]
Rock salt	14,400	15,000	17,000	13,500	16,300 [4]
Solar salt	3,580	3,810	3,310 [r]	3,390	3,330 [4]
Vacuum and open pan	4,190	4,200	4,120	4,100	4,070 [4]
Puerto Rico[e]	45	45	45	45	45
Total	45,000	45,600	44,800	40,300	43,700 [4]
Venezuela[e]	350	350	350	350	350
Vietnam	653	590	575	600 [r, e]	650
Yemen	149 [4]	150	150	150	150
Grand total	207,000 [r]	209,000 [r]	214,000 [r]	208,000 [r]	210,000

[e]Estimated. [r]Revised. NA Not available.

[1]World totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.

[2]Table includes data available through July 10, 2004.

[3]Salt is produced in many other countries, but quantities are relatively insignificant and reliable production data are not available. Some salt brine production data for manufacture of chlorine, caustic soda, and soda ash are not reported because of incomplete data reporting by many countries.

[4]Reported figure.

[5]Year ending June 30 of that stated.

[6]Less than 1/2 unit.

[7]From natural soda ash production.

[8]Brine salt produced, as reported by the Government of Burma in metric tons, was as follows: 1999--61,674; 2000--69,245; 2001--59,519; 2002--62,000 (estimated); and 2003--60,000 (estimated).

[9]Year beginning March 21 of that stated.

[10]Does not include production from Sardinia and Sicily, which is estimated to be 200,000 metric tons per year.

[11]Year ending July 15 of that stated.

[12]Data captioned "Brine salt" for the United Kingdom are the quantities of salt obtained from the evaporation of brine; those captioned "Other salt" are for salt content of brines used for purposes other than production of salt.