USGS
science for a changing world

2005 Minerals Yearbook

SALT

U.S. Department of the Interior
U.S. Geological Survey

March 2007

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.

Total U.S. salt production in 2005 decreased by 3% to 45.1 million metric tons (Mt) compared with that of 2004 (table 1). According to the U.S. Geological Survey (USGS) canvass for 2005, 29 companies operated 64 salt-producing plants in 15 States. Of these, 11 companies and 16 plants produced more than 1 Mt each and accounted for 92% and 60%, respectively, of total U.S. production and 91% and 37%, respectively, of total value. Several companies and plants produced more than one type of salt. In 2005, 14 companies (30 operations) produced salt brine; 11 companies (15 operations), rock salt; 9 companies (12 operations) produced solar-evaporated salt; and 6 companies (17 operations), vacuum pan salt.

The five leading States were, in descending order of total salt sold or used, Louisiana with 31%; Texas, 21%; New York, 15%; Kansas, 6%; and Utah, 5%. Other Eastern States (Alabama, Michigan, Ohio, Tennessee, and West Virginia) accounted for 19% of the domestic total salt sold or used. Other Western States (Arizona, California, Nevada, New Mexico, and Oklahoma) represented 3% (table 4).

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 form sodium chloride, which 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).

Production

U.S. production and sales data for salt are developed by the 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 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 2 responded, representing 14% of the totals shown in this report. Data for the nonrespondents were estimated based on their prior responses to previous annual surveys, the 2005 production estimate survey, or brine production capabilities for chloralkali manufacture based upon published chlorine production capacities [1.75 metric tons (t) of salt required per ton of chlorine capacity].

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, increased energy and labor costs, less expensive imports, fluctuations in 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 2005.

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 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. Some salt domes have depths in excess of 6,100 meters (m) (20,000 feet), whereas others crop out at the surface. The tops of Gulf Coast salt mining operations are generally less than 300 m (1,000 feet) below the surface. Working at greater 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. Calacite (calcium carbonate), which is the least soluble, will crystallize out first. Highly soluble magnesium salts tend to crystallize 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 lakewater 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 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, where 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 worldwide.

***Processing.*—Rock Salt.**—Of total rock salt produced and imported, 80% 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 of 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 cheese, butter, and baked goods.

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 because the evaporation rate is too slow and more energy is required to evaporate the brine.

Consumption

Depending on the location, winter 2005 was either mild or severe as evidenced by many nationwide newspaper articles regarding road salt use. Some parts of the nation experienced freezing rain and sleet that required road deicing and others were blanketed with numerous snowfalls that also necessitated using large quantities of road salt (Saladin and Hansel, 2004§[1]; Jones, 2005§). Salt inventories were plentiful in many parts of the country by the end of 2005 and early 2006 in anticipation of adverse winter weather that would require large quantities of rock salt for road deicing (Cohn, 2006§).

In 2005, apparent consumption (salt sold or used plus imports minus exports) was 56.2 Mt, whereas reported consumption (sales or use as reported by the salt companies, including their imports and exports) was 53.1 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 nonsalt-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 14,000 according to industry sources. The USGS annually surveys 8 major categories comprising 29 end uses. The 2005 reported percentage distribution of salt by major end use was ice control, 40%; chemicals, 37%; distributors (grocery and other wholesalers and retailers, etc.), 7%; general industrial, 6%; agricultural, 3%; food processing, 3%; primary water treatment,

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

2%; and other uses combined with exports, 2% (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.

Chemical Industry.—The leading consumer of salt, primarily salt brine, is the chemical industry. Salt brine is extracted from 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. Of the domestic chlorine and sodium hydroxide produced, 98% 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 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-base chlorine facilities, 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% (tables 5, 6).

In 2005, according to the U.S. Census Bureau, 10.3 Mt of chlorine and 8.5 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 18 Mt of salt for feedstock. Reported consumption of total domestic and imported salt for chlorine manufacture was 18.4 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 to one from three; 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 for metallic sodium was less than 30,000 t, having decreased from 126,000 t in 1978. The phasing out of tetraethyl lead and tetramethyl lead gasoline antiknock additives was the main reason for the decline in consumption. The method for making tetraalkyl lead involved the alkylation of a lead-sodium alloy with either ethyl chloride or methyl chloride. The alkyl chloride is introduced into a reactor containing the lead-sodium alloy. After the reaction is completed, the remaining alkyl chloride is vented and the product recovered.

In 1978, sodium usage in gasoline represented 80% of the domestic market. Although there is no information about sodium consumption in 2005, 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 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-ranked 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 6.5° C to 9.5° 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. Department of Health and Human Services, 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 water 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 Niño, an increase in sea-surface temperatures in the equatorial Pacific Ocean, is now thought to be the leading weather influence on Earth.

Distributors.—A tremendous amount of salt is marketed through various distributors, some of which specialize in agricultural and water treatment services, two sectors in which the salt companies also have direct sales (table 5). Distributor sales also include grocery wholesalers and/or retailers, institutional wholesalers, U.S. Government resale, and other wholesalers and retailers.

General Industrial.—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 downwell 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-base 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 attract moisture back into 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.

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.

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 as 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. This category 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 and pipes. 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 brine replenishes the lost sodium ions.

Stocks

Because bulk salt is stored at many different locations, such as 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 2005 in anticipation of severe winter weather during late 2005 to early 2006. 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 may be 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. River and lake 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 salt that can be imported is the depth of the channels and the ports; many ports are not deep enough to accommodate 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 for 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 2005, the United States exported 879,000 t; this was a 21% decrease compared with that of 2004 (table 8). In 2005, the majority of exports (78%) were to Canada. Salt was shipped to 69 countries through 31 customs districts; the Cleveland, OH, district exported the most and represented 42% of the U.S. total (table 9). Based on U.S. Census Bureau statistics, the United States imported 12.1 Mt of salt from 52 countries in 2005, which was slightly more than was imported during 2004 (table 10). Canada was the leading source of imports, representing 33% of total imports, followed by Chile (32%), the Bahamas (11%), and Mexico (8%). Table 11 lists the imports of salt by customs districts. Of the 39 customs districts that imported salt in 2005, the New York, NY,

customs district was the largest in terms of tonnage, accounting for 20% of the total. The quantity of imported salt was 14 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 U.S. customers at prices lower than the comparable domestic product because production costs are lower abroad, currency exchange rates may favor the price of imported salt rather than the price of domestic salt, and ocean freight rates are less expensive than overland rail or truck rates.

World Industry Structure

Table 12 lists world salt production statistics for 115 nations based on reported and estimated information. In 2005, the total estimated world production increased to 238 Mt. The United States remained the world's leading salt-producing country, representing 19% of total world output. China is rapidly increasing its production. In 2005, estimated salt production in China was 44.5 Mt, which makes it the second-ranked salt producer in the world.

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 to many countries. Many developing nations tend to develop their agricultural resources to feed their population first. Utilization of easily extractable mineral resources follows, and salt is one of the first mineral 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, as previously discussed.

World Review

China.—China is the world's leading producer of synthetic soda ash, which uses large quantities of salt as feedstock. Although China's chloralkali industry is concentrated in the eastern Provinces where most of the population and salt resources are located, many of the salt operations have not been able to keep up with the strong demand created by the rise in soda ash production. Salt deposits in the central and western Provinces cannot be utilized because of overland transportation difficulties, so China has had to rely on salt imports from Australia and India to satisfy its supply requirements. These two nations may not be able to supply China for long if its salt requirement continues to grow. It is expected that there will be a salt shortage in China for the next few years (Asian Chemical News, 2005).

Sri Lanka.—Aside from the tremendous toll on human lives, the large tsunami that devastated many areas of Southeast Asia on December 26 inundated thousands of rice farms, fruit plantations, and drinking-water wells with salt water. Salt crusts formed on the fields as the seawater evaporated, and saline water infiltrated the soils and contaminated many underground freshwater aquifers. Agricultural officials in Sri Lanka estimated that it would take a decade for the lands to be restored to farming again. Many coastal villages have become dependent on outside assistance for food and water. Similar salt contamination problems affected other Indian Ocean islands, such as the Maldives, and Indonesia (Pearce, 2005§).

United Kingdom.—Compass Minerals International Inc. announced plans near yearend 2005 to sell its British subsidiary (Salt Union Ltd.) to Ineos Enterprises. The salt operation produces vacuum pan salt in Weston Point, Cheshire. Ineos is the supplier of salt brine to the salt plant (Chemical Market Reporter, 2005).

Outlook

The U.S. salt industry continued in a positive direction of increased production, consumption, and world trade of salt. Despite the closing and idling of some chlorine plants during the previous several years, remaining chlorine facilities have run at higher capacity utilization rates, thereby offsetting any change in salt brine production and consumption. Because the chloralkali industry is energy-intensive, any increase in energy prices will have an adverse effect on chlorine manufacture and a corresponding effect on salt brine usage. Solar salt and vacuum pan salt production and consumption have been consistent, and the outlook is favorable for this trend to continue. Rock salt production and consumption are heavily dependent on the severity of winter weather. Although the severity of the 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.

Because salt is a relatively low-value commodity, the shipping cost for oceanic, rail, or truck transportation can be an important determining factor when attempting to secure supply sources from either domestic or foreign locations. If energy prices increase, one mode of transportation may favor one over the others. Excluding deicing salt, domestic salt consumption may fluctuate but will probably continue to grow parallel to population growth trends. U.S. total salt production in 2006 is expected to be an estimated 45 Mt.

References Cited

Asian Chemical News, 2005, China salt shortage to stay: Asian Chemical News, v. 479, no. 11, February 21-27, p. 23.

Chemical Market Reporter, 2005, Compass negotiating sale of salt plant: Chemical Market Reporter, v. 268, no. 17, February 14-20, p. 5.

U.S. Department of Health and Human Services, 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.

Internet References Cited

Cohn, Meredith, 2006, Got salt? A lack of snow and ice has caused a 50% drop in road salt sales at a big East Coast supplier, but port terminal here keeps looking skyward, Baltimore Sun, accessed February 13, 2006, at URL http://www.baltimoresun.com/business/bal-bz.salt12feb12,0,5438487,print.story?coll=bal-business-headlines.

Jones, Meg, 2005, Slippery streets beckon barrage of salt trucks, Milwaukee Journal Sentinel, accessed January 4, 2005, at URL http://www.jsonline.com/news/state/jan05/289839.asp.

Pearce, Fred, 2005, Tsunami's salt water may leave islands uninhabitable, accessed January 5, 2005, at URL http://www.newscientist.com/article.ns?id=dn6840.

Saladin, L.E., and Hansel, Mark, 2004, Six days later, we're still digging out, The Kentucky Post, accessed December 29, 2004, at URL http://www.kypost.com/2004/12/28/snow12-28-2004.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.
Handbook of World Salt Resources, 1969.
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 (7th ed.), Society for Mining, Metallurgy, and Exploration, Inc., 2006.
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)

	2001	2002	2003	2004	2005
United States:					
Production:[2]					
Brine	20,400	19,300	20,000	20,500	19,900
Rock	17,000	13,500	16,300	18,300	17,700
Solar	3,310	3,390	3,330	3,520	3,430
Vacuum and open pans	4,120	4,100	4,070	4,100	4,170
Total	44,800	40,300	43,700	46,500	45,100
Sold or used by producers:					
Quantity	42,200	37,700	41,100	45,000	45,000
Value	1,110,000	1,010,000	1,130,000	1,270,000	1,310,000
Exports:					
Quantity	1,120	689	718	1,110	879
Value	48,000	31,600	37,500	47,600	51,800
Imports for consumption:					
Quantity	12,900	8,160	12,900	11,900	12,100
Value	179,000	129,000	196,000	159,000	180,000
Consumption:					
Apparent[3]	54,000	45,100	53,200	55,800	56,200
Reported	48,700	43,600	50,200	50,700 r	53,100
World, production	214,000 r	212,000 r	218,000 r	229,000 r	238,000 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
2004:					
Bulk	728	2,170	17,800	20,500	41,200
Compressed pellets	1,310	391	XX	XX	1,710
Packaged	1,900	811	459	XX	3,170
Pressed blocks	167	147	81	XX	394
Total	4,100	3,520	18,300	20,500	46,500
2005:					
Bulk	793	2,000	17,300	19,900	39,900
Compressed pellets	1,340	392	XX	XX	1,740
Packaged	1,880	876	355	XX	3,110
Pressed blocks	156	155	78	XX	388
Total	4,170	3,430	17,700	19,900	45,100

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
2004:										
Bulk	718	44,800	1,600	37,200	16,900	408,000	20,500	144,000	39,700	634,000
Compressed pellets	1,330	184,000	364	41,800	XX	XX	XX	XX	1,700	226,000
Packaged:										
Less-than-5-pound units	218	NA	8	NA	(3)	NA	XX	XX	227	XX
More-than-5-pound units	1,610	NA	945	NA	455	NA	XX	XX	3,010	XX
Total	1,830	269,000	953	64,400	456	39,000	XX	XX	3,240	372,000
Pressed blocks:										
For livestock	102	NA	107	NA	75	NA	XX	XX	284	XX
For water treatment	63	NA	25	NA	5	NA	XX	XX	93	XX
Total	165	17,400	131	12,300	81	8,340	XX	XX	377	38,000
Grand total	4,040	515,000	3,040	156,000	17,400	456,000	20,500	144,000	45,000	1,270,000
2005:										
Bulk	751	53,500	1,520	41,400	17,700	438,000	19,800	139,000	39,800	672,000
Compressed pellets	1,340	192,000	372	46,600	XX	XX	XX	XX	1,710	238,000
Packaged:										
Less-than-5-pound units	204	NA	9	NA	(3)	NA	XX	XX	213	XX
More-than-5-pound units	1,530	NA	1,000	NA	357	NA	XX	XX	2,890	XX
Total	1,730	254,000	1,010	80,600	357	28,900	XX	XX	3,100	364,000
Pressed blocks:										
For livestock	96	NA	111	NA	73	NA	XX	XX	280	XX
For water treatment	57	NA	26	NA	4	NA	XX	XX	86	XX
Total	152	16,700	137	14,100	78	8,640	XX	XX	367	39,400
Grand total	3,970	516,000	3,040	183,000	18,100	475,000	19,800	139,000	45,000	1,310,000

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 ½ unit.

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

(Thousand metric tons and thousand dollars)

State	2004		2005	
	Quantity	Value	Quantity	Value
Kansas	2,890	127,000	2,890	135,000
Louisiana	14,300	186,000	13,800	182,000
New York	6,430	301,000	6,840	327,000
Texas	9,780	118,000	9,600	118,000
Utah	2,250	107,000	2,250	132,000
Other Eastern States[3]	8,090	360,000	8,400	347,000
Other Western States[4]	1,250	71,200	1,250	73,500
Total	45,000	1,270,000	45,000	1,310,000
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]	
		2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
Chemical:											
Chloralkali producers	2812	18	17	315	301	714 r	514	18,200	17,600	19,200	18,400
Other chemical	28 (excludes 2812, 2899)	260 r	274	207 r	219	773 r	689	2	78	1,240 r	1,260
Total		278 r	291	522 r	519	1,490 r	1,200	18,200	17,700	20,400 r	19,700
Food-processing industry:											
Meat packers	201	243 r	260	53 r	62	89 r	76	--	--	385 r	398
Dairy	202	119 r	122	9	8	3	3	--	--	131 r	134
Canning	2091, 203	149 r	141	36 r	33	39 r	36	1	(4)	225	211
Baking	205	192 r	187	4 r	4	12	13	--	--	209 r	204
Grain mill products	204 (excludes 2047)	90 r	89	7	6	14	19	--	--	110 r	133
Other food processing	206-208, 2047, 2099	562 r	584	78	74	96	75	1	2	737 r	736
Total		1,350 r	1,380	187 r	187	252 r	222	2	3	1,800 r	1,800
General industrial:											
Textiles and dyeing	22	102 r	107	33 r	32	10 r	10	(4)	(4)	145 r	149
Metal processing	33, 34, 35, 37	12 r	12	23 r	20	78 r	74	(4)	(4)	112 r	107
Rubber	2822, 30 (excludes 3079)	3	3	1	(4)	2	1	64	60	69	65
Oil	13, 29	33 r	31	191 r	190	49 r	46	2,070	1,940	2,350 r	2,210
Pulp and paper	26	10	9	44 r	41	14 r	13	18	17	86 r	81
Tanning and/or leather	311	9 r	9	13 r	11	35	35	--	--	56 r	55
Other industrial	XX	130	131	92 r	63	489 r	150	1	(4)	712 r	344
Total		300	302	396 r	357	677 r	330	2,160	2,020	3,530 r	3,010

See footnotes at end of table.

TABLE 5—Continued

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]	
		2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
Agricultural:											
Feed retailers and/or dealers mixers	5159	317 r	326	367 r	391	407	426	--	(4)	1,090	1,140
Feed manufacturers	2048	41 r	41	128 r	132	283	304	--	--	451 r	477
Direct-buying end user	02	4	4	16 r	13	25 r	22	--	--	45 r	38
Total		362 r	371	511 r	536	715 r	753	--	(4)	1,590 r	1,660
Water treatment:											
Government (Federal, State, local)	2899	18 r	17	108 r	321	126 r	134	3 r	3	255 r	476
Commercial or other	2899	162	169	246 r	335	192 r	152	3 r	8	603 r	664
Total		180 r	186	354 r	656	318 r	287	6 r	11	858 r	1,140
Ice control and/or stabilization:											
Government (Federal, State, local)	9621	1	1	857 r	948	14,700 r	17,300	--	--	15,600 r	18,200
Commercial or other	XX	5	7	211 r	175	2,170 r	2,560	--	--	2,380 r	2,740
Total		6	8	1,070 r	1,120	16,900 r	19,800	--	--	18,000 r	21,000
Distributors:											
Agricultural distribution	5191	70 r	68	114 r	106	57	53	--	--	242 r	227
Grocery wholesalers and/or retailers	514, 54	513 r	513	215	234	66 r	57	--	--	794 r	803
Institutional wholesalers and end users	58, 70	108 r	108	55 r	64	49	55	(4)	(4)	212 r	228
Water-conditioning distribution	7399	118	119	369	358	26	33	1	1	514	511
U.S. Government resale	9199	(4)	(4)	(4)	1	1	1	--	--	1	1
Other wholesalers and/or retailers	5251	904 r	876	917 r	938	373 r	374	9	10	2,200 r	2,200
Total		1,710	1,680	1,670 r	1,700	572 r	573	10	11	3,970 r	3,970
Other[5]		101 r	96	33 r	115	472 r	436	125	238	731 r	885
Grand total		4,300 r	4,320	4,740 r	5,190	21,400 r	23,600	20,300	20,000	50,700 r	53,100

rRevised. XX Not applicable. -- Zero.

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

[2]The quantity 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 ½ 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)

Destination	2004				2005			
	Evaporated				Evaporated			
	Vacuum and open pans	Solar	Rock	Total	Vacuum and open pans	Solar	Rock	Total
Alabama	69	3	74 r	145 r	81	3	69	154
Alaska	3	5	-- r	8	5	3	--	9
Arizona	12 r	105 r	2 r	120 r	12	105	1	118
Arkansas	49	2	47 r	99 r	49	3	48	100
California	220 r	689 r	3	912 r	220	648	3	871
Colorado	12	84 r	169	265 r	12	83	166	261
Connecticut	15 r	123 r	182	320 r	15	112	198	325
Delaware	5 r	13 r	2	21 r	6	13	5	23
District of Columbia	1	27	(3)	28	1	35	5	41
Florida	88	215 r	6	309 r	84	253	5	341
Georgia	85	59 r	49 r	193 r	87	48	49	184
Hawaii	(3)	1	--	2 r	(3)	1	--	1
Idaho	20 r	110 r	2	132 r	21	100	1	122
Illinois	340 r	121 r	1,800 r	2,260 r	343	119	2,360	2,820
Indiana	261 r	128 r	862 r	1,250 r	263	122	922	1,310
Iowa	132 r	111 r	516 r	758 r	133	119	629	882
Kansas	87	62	724 r	873 r	86	66	296	448
Kentucky	60 r	5	674 r	740 r	60	6	675	741
Louisiana	61 r	2	591 r	654 r	51	3	342	396
Maine	15	15 r	177 r	206 r	15	15	252	282
Maryland	64	87 r	21	172 r	65	172	23	259
Massachusetts	31 r	253 r	272 r	555 r	34	79	331	444
Michigan	276 r	45 r	2,530 r	2,850 r	281	44	2,900	3,230
Minnesota	160 r	213 r	573 r	946 r	134	200	829	1,160
Mississippi	35 r	1	247 r	283 r	31	1	219	251
Missouri	144 r	60 r	564 r	768 r	148	63	367	578
Montana	1	34 r	1	36 r	1	42	0	43
Nebraska	60 r	44 r	177 r	282 r	60	46	172	277
Nevada	6 r	280 r	(3)	285 r	6	256	0	262
New Hampshire	16 r	82 r	94 r	191 r	16	101	187	304
New Jersey	115 r	68 r	78	261 r	118	124	78	320
New Mexico	18 r	70	2	89	18	70	0	88
New York	196 r	52 r	2,850 r	3,090 r	196	40	3,190	3,420
North Carolina	116 r	89 r	108 r	313 r	116	61	98	275
North Dakota	6 r	14 r	4	24 r	11	13	5	29
Ohio	419 r	48 r	2,730 r	3,200 r	446	49	3,280	3,780
Oklahoma	35 r	23	42 r	100 r	33	26	45	104
Oregon	17	103 r	(3) r	121 r	17	110	0	127
Pennsylvania	186 r	115 r	2,020 r	2,320 r	187	92	2,260	2,540
Rhode Island	4	174 r	2 r	181 r	5	675	1	681
South Carolina	36 r	9 r	8	53 r	31	6	3	40
South Dakota	19	52 r	33	105 r	19	50	47	117
Tennessee	116	7 r	535 r	658 r	127	8	464	598
Texas	231 r	161 r	162 r	555 r	234	165	150	548
Utah	13 r	346 r	136	495 r	13	286	112	411
Vermont	7	5	347 r	359 r	6	5	419	430
Virginia	69 r	109 r	69 r	247 r	69	147	112	327
Washington	28 r	126 r	8	161 r	27	128	13	168
West Virginia	12	5	176 r	193 r	13	7	187	207
Wisconsin	215 r	145 r	1,280 r	1,640 r	215	149	1,720	2,080

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]

(Thousand metric tons)

	2004				2005			
	Evaporated				Evaporated			
Destination	Vacuum and open pans	Solar	Rock	Total	Vacuum and open pans	Solar	Rock	Total
Wyoming	(3)	20 r	2	22 r	(3)	20	2	22
Other[4]	110 r	22	438	571 r	100	101	399	600
Total[5]	4,300 r	4,740 r	21,400 r	30,400 r	4,320	5,190	23,600	33,200

rRevised. -- 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 ½ 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
2004:				
Bulk	62.36	23.33	24.22	7.01
Compressed pellets	138.26	114.85	XX	XX
Packaged	147.13	67.59	85.55	XX
Average[2]	128.39	49.25	25.83	7.01
Pressed blocks	105.30	93.53	103.57	XX
2005:				
Bulk	71.23	27.30	24.73	7.03
Compressed pellets	143.77	125.14	XX	XX
Packaged	146.50	79.69	80.89	XX
Average[2]	130.75	58.14	25.84	7.03
Pressed blocks	109.71	102.91	111.08	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	2004		2005	
	Quantity	Value[2]	Quantity	Value[2]
Argentina	1	91	1	214
Bahamas, The	1	213	1	251
Bahrain	1	322	1	256
Belgium	2	289	2	284
Canada	971	31,100	686	32,700
Chile	1	216	(3)	86
China	4	204	9	395
Colombia	1	250	4	461
Costa Rica	2	183	3	355
Dominican Republic	(3)	124	(3)	135
El Salvador	1	172	1	219
Germany	1	1,140	20	1,000
Honduras	14	1,640	9	1,220
Hong Kong	1	276	1	310
Israel	(3)	29	(3)	41
Italy	(3)	31	(3)	252
Japan	2	2,130	22	2,860
Korea, Republic of	1	190	(3)	224
Kuwait	(3)	93	(3)	258
Lebanon	2	226	1	139
Malaysia	4	271	2	85
Mexico	74	3,620	92	4,270
Netherlands	2	344	1	153
Norway	1	93	1	307
Panama	1	116	1	115
Philippines	4	394	2	164
Saudi Arabia	10	916	6	1,480
United Arab Emirates	3	609	1	462
United Kingdom	4	839	3	731
Other	4	1,480	12	2,360
Total	1,110	47,600	879	51,800

[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 ½ unit.

Source: U.S. Census Bureau.

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

(Thousand metric tons and thousand dollars)

District	2004		2005	
	Quantity	Value[2]	Quantity	Value[2]
Anchorage, AK	3	156	1	260
Baltimore, MD	2	571	5	1,310
Buffalo, NY	61	3,020	34	3,100
Charleston, SC	(3)	23	(3)	11
Chicago, IL	1	1,180	20	2,400
Cleveland, OH	423	9,950	373	11,200
Dallas-Fort Worth, TX	(3)	36	(3)	61
Detroit, MI	237	7,660	60	5,290
Duluth, MN	14	278	(3)	47
El Paso, TX	17	941	5	291
Great Falls, MT	5	668	10	888
Honolulu, HI	(3)	13	(3)	44
Houston, TX	19	3,170	18	3,070
Laredo, TX	50	2,200	71	3,370
Los Angeles, CA	14	2,180	34	2,270
Miami, FL	2	528	6	1,410
Mobile, AL	7	599	2	182
New Orleans, LA	1	135	(3)	71
New York, NY	16	1,680	8	2,300
Nogales, AZ	3	109	2	78
Norfolk, VA	1	193	1	318
Ogdensburg, NY	13	1,450	51	2,750
Pembina, ND	3	410	3	597
Philadelphia, PA	(3)	414	1	124
Portland, ME	--	--	(3)	63
St. Albans, VT	(3)	16	(3)	33
San Diego, CA	5	387	14	546
San Francisco, CA	23	763	36	1,680
Savannah, GA	(3)	77	(3)	56
Seattle, WA	21	1,140	10	978
Tampa, FL	1	216	1	149
Other[4]	171	7,410	114	6,850
Total	1,110	47,600	879	51,800

-- 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 ½ 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	2004		2005	
	Quantity	Value[2]	Quantity	Value[2]
Australia	(3)	34	1	112
Bahamas, The	1,110	11,600	1,370	14,200
Belgium	11	131	1	235
Brazil	93	1,840	150	2,220
Canada	4,240	62,900	3,950	62,600
Chile	3,370	31,200	3,840	49,700
China	4	1,260	12	2,010
Colombia	5	234	4	410
Egypt	414	3,340	588	5,820
France	10	3,780	30	4,960
Germany	6	1,350	4	1,200
India	38	438	(3)	9
Ireland	96	683	17	120
Israel	1	729	2	730
Italy	93	1,690	49	1,310
Japan	1	121	(3)	46
Korea, Republic of	3	676	1	761
Mexico	1,120	15,000	927	14,700
Netherlands	127	4,510	62	2,180
Netherlands Antilles	436	8,090	270	5,280
New Zealand	4	253	4	360
Pakistan	(3)	71	(3)	59
Panama	44	946	102	1,670
Peru	346	2,600	500	3,930
South Africa	3	197	6	461
Spain	1	585	3	1,480
United Kingdom	204	2,500	140	2,220
Venezuela	131	1,480	40	404
Other	1	627	6	871
Total	11,900	159,000	12,100	180,000

[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 ½ unit.

Source: U.S. Census Bureau.

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

(Thousand metric tons and thousand dollars)

District	2004		2005	
	Quantity	Value[2]	Quantity	Value[2]
Anchorage, AK	2	252	23	722
Baltimore, MD	1,190	16,800	1,030	18,200
Boston, MA	986	11,100	1,290	16,100
Buffalo, NY	131	3,620	57	1,530
Charleston, SC	197	4,530	128	3,080
Charlotte, NC	--	--	73	2,020
Chicago, IL	896	11,800	525	7,580
Cleveland, OH	386	5,030	337	4,500
Columbia-Snake, OR	(3)	5	(3)	91
Dallas-Fort Worth, TX	(3)	18	(3)	32
Detroit, MI	1,160	20,500	1,510	25,000
Duluth, MN	189	2,710	67	869
El Paso, TX	--	--	(3)	2
Great Falls, MT	1	61	2	210
Honolulu, HI	(3)	20	(3)	3
Houston-Galveston, TX	1	759	4	925
Laredo, TX	1	373	1	289
Los Angeles, CA	72	2,300	121	3,620
Miami, FL	(3)	194	(3)	166
Milwaukee, WI	931	8,380	839	12,100
Minneapolis, MN	(3)	26	44	662
Mobile, AL	(3)	48	(3)	34
New Orleans, LA	146	1,880	19	654
New York, NY	2,680	30,300	2,480	34,900
Nogales, AZ	(3)	61	(3)	23
Norfolk, VA	163	1,570	112	1,500
Ogdensburg, NY	172	3,260	162	2,390
Pembina, ND	2	291	3	499
Philadelphia, PA	951	10,200	1,110	13,700
Portland, ME	613	6,390	1,060	12,400
Providence, RI	506	5,860	706	7,410
St. Albans, VT	13	974	2	309
St. Louis, MO	3	234	5	315
San Diego, CA	1	163	1	259
San Francisco, CA	1	396	4	729
San Juan, PR	6	263	4	425
Savannah, GA	40	1,000	42	1,590
Seattle, WA	15	774	2	603
Tampa, FL	354	5,380	309	4,710
Wilmington, NC	99	1,410	--	--
Total	11,900	159,000	12,100	180,000

-- 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 ½ unit.

Source: U.S. Census Bureau.

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

(Thousand metric tons)

Country[3]	2001	2002	2003	2004[e]	2005[e]
Afghanistan, rock salt[e]	13	13	13	13	12
Albania	26	23	21 [r]	25 [r, 4]	20
Algeria, brine and sea salt	185	205	191	183	197
Angola[e]	30	30	30	30	30
Argentina	1,270	1,080	1,668 [r]	1,362 [r, 4]	1,400
Armenia	30 [e]	30	32	32	33
Australia, salt and marine salt	9,536	9,887	9,800 [e]	11,221 [4]	12,384 [4]
Austria:[e]					
Brine salt	400	400	400	400	400
Rock salt	1	1	1	1	1
Total	401	401	401	401	401
Azerbaijan	4 [e]	5	8	8	8
Bahamas, The	900 [e]	900 [e]	1,342 [r]	1,269 [r, 4]	1,270
Bangladesh, marine salt[e, 5]	350	350	350	350	350
Belarus[e]	300	300	300	300	300
Bolivia	(6)	4	2	1 [r, 4]	1
Bosnia and Herzegovina[e]	90 [r]	98 [r]	84 [r]	85 [r]	85
Botswana[7]	179	315	229	208 [4]	210
Brazil:					
Brine salt	4,370	4,835	5,144	5,206 [r, 4]	5,210 [p]
Rock salt	1,208	1,274	1,420 [r]	1,442 [r, 4]	1,450 [p]
Total	5,578	6,109	6,564 [r]	6,648 [r, 4]	6,660 [p]
Bulgaria	1,931	1,800 [e]	1,882	1,900 [r]	1,900
Burkina Faso[e]	5	5	5	5	5
Burma[e, 8]	35	35	35	35	35
Cambodia[e]	40	40	40	40	40
Canada	13,725	12,736	13,718 [r]	14,125 [4]	14,500 [4]
Cape Verde[e]	2	2	2	2	2
Chile	5,989	3,503	6,213	4,939 [r, 4]	4,940
China	34,105	36,024	32,424	37,101 [4]	44,547 [4]
Colombia:					
Marine salt	286 [r]	336	248	294 [r, 4]	300
Rock salt	110 [r]	192	199	232 [r, 4]	250
Total	396 [r]	527	447	526 [r, 4]	550
Costa Rica, marine salt[e]	37	37	37	37	37
Croatia	33	37	31	23 [r]	25
Cuba	180	180 [e]	180 [e]	188 [r]	190
Denmark, sales[e]	600	600	605	610	610
Djibouti	173	162	128	30	30
Dominican Republic:					
Marine salt[e]	50	50	50	50	50
Rock salt	190	157	107	-- [r]	--
Total	240	207	157	50 [r]	50
Ecuador[e]	90	90	90	90	90
Egypt[e]	2,400	2,400	2,400	2,400	2,400
El Salvador, marine salt	32	32	31	31	31
Eritirea, marine salt	78	116	5 [r]	3 [r, 4]	3
Ethiopia, rock salt[e, 5]	90 [r]	120 [r]	145 [r]	200 [r, 4]	200
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

See footnotes at end of table.

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

(Thousand metric tons)

Country[3]	2001	2002	2003	2004[e]	2005[e]
Georgia[e]	30	30	30	30	30
Germany:					
Industrial brines	7,629	8,307	9,078	10,432 [4]	10,400
Rock salt and other	5,887 [r]	6,468 [r]	6,495 [r]	7,692 [r, 4]	7,700
Salt, evaporated	827 [r]	858 [r]	727 [r]	572 [r, 4]	572
Total	14,343 [r]	15,632 [r]	16,300 [r]	18,696 [r, 4]	18,700
Ghana[e]	68	99	250	265 [r]	265
Greece[e]	150	150	150	150	150
Guadeloupe[e]	49	49	49	49	49
Guatemala[e]	50	50	60 [r]	60 [r]	60
Guinea[e]	15	15	15	15	15
Honduras[e]	25	25	26 [r]	26 [r]	26
Iceland[e]	5	5	5	5	5
India:[e]					
Marine salt	14,500	14,500	15,000	15,000	15,500
Rock salt	3	3	3	3	3
Total	14,500 [r]	14,500 [r]	15,000 [r]	15,000	15,500
Indonesia[e]	680	680	680	680	680
Iran[9]	1,559 [r]	1,664 [r]	2,003 [r]	1,791 [r, 4]	2,000
Iraq[e]	300	203 [4]	50	50	25
Israel	460 [r, e]	392 [r]	376 [r]	398 [r, 4]	400
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[e]	19 [4]	19	19	19	19
Japan	1,358	1,282	1,263 [r]	1,273 [r, 4]	1,250
Jordan	329	407	12 [r]	29 [r, 4]	29
Kenya, crude salt	6	19	21 [r]	31 [r, 4]	32
Korea, North[e]	500	500	500	500	500
Korea, Republic of[e]	800	800	800	800	800
Kuwait[e]	43 [r]	45 [r]	45 [r]	50 [r]	50
Laos, rock salt	3	5	16	15	15
Lebanon[e]	4	4	4	4	4
Libya[e]	40	40	40	40	40
Madagascar[e]	26 [4]	17	26 [r]	26 [r]	26
Mali[e]	6	6	6	6	6
Malta, marine salt[e]	(6)	(6)	(6)	(6)	(6)
Martinique[e]	200	200	200	200	200
Mauritania[e]	6	6	(6) [r, 4]	(6) [r, 4]	(6)
Mauritius	7	7	7 [e]	8	8
Mexico	8,501	7,802	7,547	8,566 [r, 4]	9,242 [4]
Mongolia, mine output	2	1	2	2	2 [4]
Morocco, marine and rock salt	234	267 [r]	237 [r]	254 [r, 4]	254
Mozambique, marine salt[e]	10	80	80	80	80
Namibia, marine salt	543	630	698	754 [r]	700
Nepal[e, 11]	5	5	5	4	4
Netherlands[e]	5,000	5,000	5,000	5,000	5,000
Netherlands Antilles[e]	500	500	500	500	500
New Zealand[e]	70	70	70	70	70
Nicaragua, marine salt	18	30	31	31	31
Niger[e]	2	2	2	2	2
Oman	14	14	15 [e]	15	15

See footnotes at end of table.

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

(Thousand metric tons)

Country[3]	2001	2002	2003	2004[e]	2005[e]
Pakistan:[e, 5]					
Marine salt	20	20	20	20	20
Rock salt	1,300	1,300	1,300	1,300	1,300
Total	1,320	1,320	1,320	1,320	1,320
Panama, marine salt[e]	23	23	23	23	23
Peru	419	279	187	249 [4]	250
Philippines, marine salt[e]	600	600	600	600	600
Poland:					
Rock salt	787	839	848	1,099 [r, 4]	1,100
Recovered from brine	2,689 [r]	2,719 [r]	3,812 [r]	4,043 [r, 4]	3,900
Total	3,476 [r]	3,558 [r]	4,660 [r]	5,142 [r, 4]	5,000
Portugal, rock salt[e]	600	600	600	600	600
Romania:					
Rock salt	48	46 [e]	47	43 [r]	45
Other	2,224 [r]	2,257 [r]	2,417 [r]	2,398 [r, 4]	2,400
Total	2,272 [r]	2,303 [r]	2,464 [r]	2,441 [r, 4]	2,450
Russia[e]	2,800 [4]	2,800	2,800	2,800	2,800
Saudi Arabia[e]	200 [4]	220 [r]	220 [r]	230 [r]	230
Senegal[e]	110 [4]	1,720 [r]	235 [r]	240 [r]	240
Serbia and Montenegro	62	42	78 [r]	75 [r]	75
Slovakia[e]	123	97	95	95 [r]	95
Slovenia[e]	108	128	125	125	125
Somalia[e]	1	1	1	1	1
South Africa	354 [r]	429 [r]	441 [r]	395 [r, 4]	383 [p]
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	130	73	79	79	80
Sudan	78	83	61 [r]	62 [r]	62
Switzerland[e]	300	300	300	300	300
Syria	190	146	146 [e]	146	146
Taiwan, marine salt	66	57	(6)	-- [4]	--
Tanzania	65	71	59	57 [r, 4]	58
Thailand:					
Rock salt	853	909	892	1,031 [r, 4]	1,000
Other[e]	100	100	100	100	100
Total	953	1,009	992	1,131 [r, 4]	1,100
Tunisia, marine salt	654	616	700 [e]	608 [4]	600
Turkey	1,771	2,197	2,243	2,158 [r, 4]	2,200
Turkmenistan[e]	215	215	215	215	215
Uganda[e]	5	5	5	5	5
Ukraine[e]	2,300	2,300	2,300	2,300	2,300
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	20,400	19,300	20,000	20,500 [4]	19,900 [4]
Rock salt	17,000	13,500	16,300	18,300 [4]	17,700 [4]
Solar salt	3,310	3,390	3,330	3,520 [4]	3,430 [4]
Vacuum and open pan	4,120	4,100	4,070	4,100 [4]	4,170 [4]

See footnotes at end of table.

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

(Thousand metric tons)

Country[3]	2001	2002	2003	2004[e]	2005[e]
United States, including Puerto Rico—Continued:					
Puerto Rico[e]	45	45	45	45	45
Total	44,800	40,300	43,700	46,500 [4]	45,200 [4]
Venezuela[e]	350	350	350	350	350
Vietnam	669	1,089	1,275	1,300	1,400
Yemen[e]	95	125	116	120	120
Grand total	214,000 [r]	212,000 [r]	218,000 [r]	229,000 [r]	238,000

[e]Estimated. [p]Preliminary. [r]Revised. -- Zero.

[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 5, 2006.

[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 ½ unit.

[7]From natural soda ash production.

[8]Brine salt produced, as reported by the Government of Burma in metric tons, was as follows: 2001—61,466; 2002—59,825; 2003—73,112; 2004—58,395 (revised); and 2005—58,000 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; that captioned "Other salt" are for salt content of brines used for purposes other than production of salt.