

Salt

Michel Dumont

*The author is with the Minerals and Metals Sector,
Natural Resources Canada.
Telephone: 613-995-2917
E-mail: michel.dumont@nrcan-rncan.gc.ca*

HIGHLIGHTS

- Salt is critical to human and animal health. In insufficient quantities, our muscles won't contract, our blood won't circulate, our food won't digest, and our hearts won't beat.
- Due to severe North American winter (2007-08) weather conditions, 2008 data indicate Canadian shipments of salt increased by 18.4% (or 2.2 Mt) to 14.2 Mt valued at \$537.8 million.
- Preliminary 2008 Canadian data indicate total salt exports of 4.9 Mt (valued at \$121.2 million), of which 99.6% was exported to the United States.
- Sifto Canada Inc., located in Goderich, Ontario (a subsidiary of Compass Minerals International Inc.), expanded capacity by 750 000 short tons (st) resulting in a total mine annual capacity of 7.25 million st. An additional 1 million st of annual capacity is scheduled to be completed by 2010.
- Consequent to growing demand from the Chinese chemical industry, global demand is expected to grow at an average of 3%/y, reaching over 300 Mt by 2012.

INTRODUCTION

Salt (i.e., sodium chloride) is such a common part of our everyday lives that we rarely think of it as a natural resource that must be discovered, boiled/evaporated or mined, processed, marketed, and consumed. Each human being contains about 113 g of salt. With insufficient quantities, our muscles won't contract, our blood won't circulate, our food won't digest, and our hearts won't beat. The same is true for livestock; therefore, salt is critical to human and animal health.

Although dietary intake can vary for people from various countries, on average an adult's total salt intake should be no more than 6 g per day and a child's no more than 4 g. The average person's diet incorporates at least 9 g per day. Dietary sodium is measured in milligrams (mg). The most common form of sodium used is table salt, which is 40% sodium. One teaspoon of table salt contains 2300 mg of sodium.

The salt markets in developed regions such as North America and Western Europe are both stable and mature. The main consuming regions are North America, Asia and the Middle East, and Western Europe. World salt consumption is on the rise, mainly in response to increasing demand in Southeast Asia and other developing nations. China is the world's leading producer of synthetic soda ash (source: U.S. Geological Survey [USGS] 2006 salt review), which uses large quantities of salt as feedstock, and many of China's salt operations have not been able to keep up with the strong demand created by the rise in soda ash production.

Canada, like many countries, extracts, processes, consumes, exports, and imports salt. Canada has a vast territory with many known deposits and significant geological potential for new discoveries. Known salt areas are currently exploited by a small number of companies that are large players in the industry. Most of the salt is used for de-icing, chemical production, and domestic (e.g., table, food-grade, livestock feed) consumption.

Major Canadian salt deposits are found in Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba, Saskatchewan, and Alberta. Since similar geological conditions are necessary, many salt deposits have been discovered while exploring for oil and gas and potash. The largest deposits are in western Canada, followed by Ontario and the Atlantic provinces. In western Canada, the salt beds extend from the Northwest Territories down through Alberta, Saskatchewan, and into Manitoba. This immense deposit, averaging 122 m (400 ft) in thickness and covering an area of approximately 390 000 km² (150 000 square miles), contains more than one million billion tonnes of salt.

In Ontario, salt is found along the shores of Lake Huron and Lake Erie. This deposit is part of the known Michigan Basin and is a saucer-shaped formation underlying part of Michigan, part of Ohio, and lakes Huron and Erie.

In Prince Edward Island, a rock salt deposit of undetermined size was encountered at a depth of over 4200 m under Hillsborough Bay on the southern side of the island. Brine springs, usually indicative of salt deposits, have been found in Newfoundland and Labrador and in British Columbia. Production in most provinces is by two main methods of extraction (i.e., underground room-and-pillar mining and brining). Recovery as a co-product of potash mining is also practised.

In the Atlantic provinces, large, thick deposits have been found underlying New Brunswick, Nova Scotia, part of Newfoundland and Labrador, and even the Gulf of St. Lawrence. These deposits occurred in various geologic eras and all of them are the remains of ancient inland seas. The shorelines of these ancient seas, which outline the edges of the salt beds, often indicate the presence of oil, gas, and coal deposits.

Major salt deposits and dry salt production in North America can be viewed on the Internet at www.saltinstitute.org/images/map.pdf.

Environmentally, the continued use of road salt in Canada is an issue. In April 2004, Environment Canada issued a *Code of Practice for the Environmental Management of Road Salts*. The Code applies to any organization that uses more than 500 t/y of road salts.

PRODUCTION AND TRADE

Salt is a widespread, low-value, bulk commodity. It is relatively easy to extract, and transportation represents a significant proportion of the total delivered price. Many global markets are served by neighbouring salt-producing countries; therefore, long-distance trade is limited (Table 1). Nevertheless, even though both Canada and the United States produce salt, some regions on both sides of the border still rely, for economic reasons and convenience of supply, on large quantities of imports.

In 2007, total estimated world production (source: USGS) decreased to 257 Mt from the revised 262 Mt in 2006.

Canada (source: USGS 2007 salt review) remained the fifth largest producer of salt (Table 3) in 2007. Preliminary 2008 data indicate that Canadian salt shipments were valued at \$537.9 million (14.2 Mt), a \$94.9 million increase from the 12.0 Mt shipped in 2007. This 2008 value reflects the cyclical production level from year to year in response to winter conditions since 1988 (Table 2).

Preliminary 2008 data (Table 1) also indicate that Canada exported a total of 4.9 Mt (valued at \$121.2 million), of which 99.6% was exported to the United States (valued at \$87.4 million). With exports of almost 4.8 Mt to the United States in 2007, Canada was that country's leading source of salt imports, accounting for about 49% of its total imports (source: USGS).

Canada also imports salt. Preliminary data (Table 1) show that Canada imported 1.9 Mt in 2008 (valued at \$73.6 million), mostly from the United States (61.0%) and Mexico (22.3%).

CONSUMPTION

Of the millions of tonnes of dry salt produced annually in North America, a very small percentage finds its way to family dining tables either in commercially processed foods, in home preparations, or in the salt shaker. Globally, the largest markets for salt are for use as brine and dry salt in the chemical industry. Directly or indirectly, salt plays a part in the manufacture of a seemingly endless list of chemicals and chemical products. On average, chemical raw materials represent 60% of world salt consumption, followed by table salt (20%) and road de-icing salt (10%); the remaining 10% is used in animal feed and water treatment.

Consumption patterns differ in North America. On a per-capita basis, Canada is the largest consumer of salt in the world, and this is due mainly to its winter conditions. Canada's per-capita consumption of salt has been estimated at over 360 kg per person. Most of the salt is used as a de-icing agent in Ontario, Quebec, and Atlantic Canada. Roughly 90-95% of Canada's apparent domestic consumption (source: Canadian Salt Institute) is for chemical and de-icing purposes. The remainder is used for water conditioning, food processing, fisheries, and other industrial uses.

Salt consumption details provided by the USGS may well reflect North American consumption patterns. In 2007, the U.S. distribution of salt (source: USGS) by major end use was for: chemicals (40%); ice control (39%); distributors (grocery, other wholesalers and retailers) (8%); general industrial (3%); agricultural (3%); food processing (3%); primary water treatment (2%); and other uses (2%).

The U.S. Salt Institute's web site provides an explanation of the many uses of salt. It can be found at www.saltinstitute.org/16.html.

The industrial chemicals industry (source: Natural Resources Canada) uses salt in the manufacture of chlor-alkali such as caustic soda (sodium hydroxide), chlorine, and sodium chlorate. Salt for caustic soda and chlorine plants (i.e., facilities) in Canada is obtained from on-site brining and natural brines. Other plants use mined rock salt or imported solar or evaporated salt. The chlor-alkali industry is by far the largest segment of the chemical sector that uses salt. Other industrial chemical production that requires significant use of salt includes sodium bicarbonate, sodium chlorite, sodium hypochlorite, sodium carbonate (soda ash), and calcium chloride. For example, salt goes into the production of chlorine and into the manufacture of soda ash; in turn, these two products are used in the processing or manufacture of a wide variety of end products ranging

from rayon, polyester, and other synthetics to plastics for explosives, fertilizers, glass, and cosmetics. Salt consumption for chemical uses, particularly chlor-alkali manufacture, can fluctuate depending on the demand for chlorine and co-product sodium hydroxide.

Most pulp and paper mills in Canada have carried out extensive process modifications and improvements in effluent treatment. Several have opted to reduce chlorine usage by installing other bleaching processes such as extended lignification, oxygen delignification, sodium chlorate bleaching, integrated chlorine dioxide with hydrochloric acid recycling, and ozone and hydrogen peroxide bleaching processes.

Sodium chloride, or salt, remains the primary highway de-icing agent. Different de-icers are used in accordance with site requirements. Calcium chloride is the second most used de-icer, being effective at temperatures ranging between -10° and -20°C ; this chemical is usually mixed with salt at a 2-4% rate. Growing concerns over the environment and the corrosion of infrastructure, such as bridge decks and parking lots, have led to numerous experiments with de-icing salt substitutes.

As described above, demand for Canadian brine production has been affected by the bleaching process and the economic downturn; this is reflected in the downward trend (Table 2, Figure 1) seen from 2001 and 2006, respectively.

CANADIAN SALT PRODUCERS

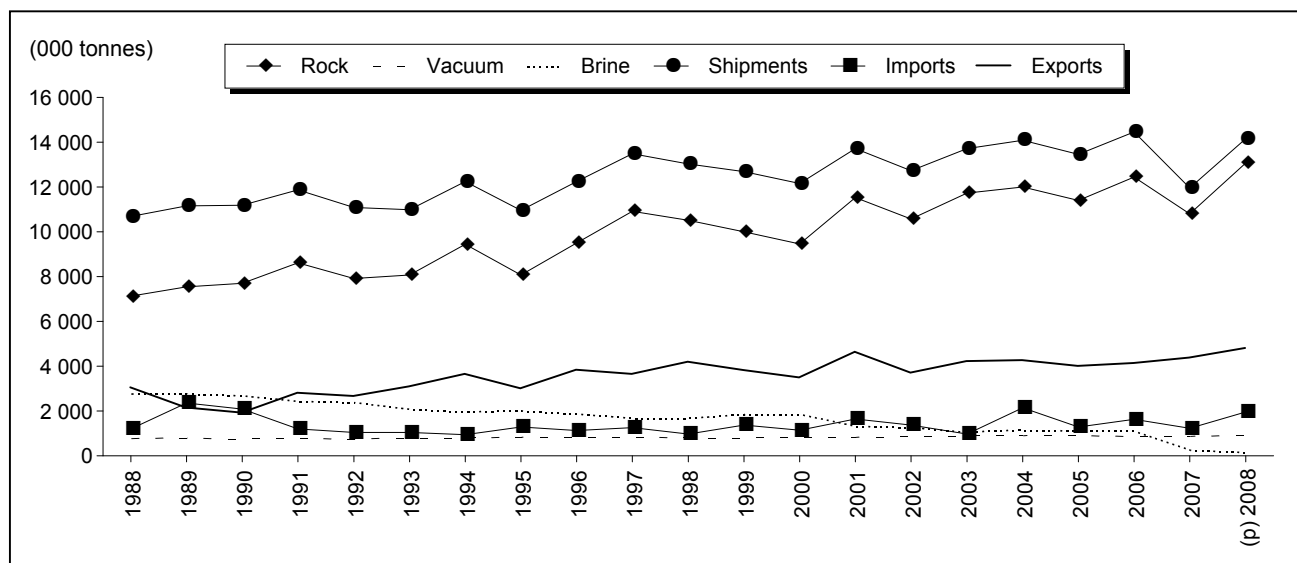
In 2007 (source: USGS and Table 3), the top eight salt-producing nations collectively accounted for 69.6% of total world salt output of 257.0 Mt. In descending order of quantity produced (Mt, revised), the top eight were: China (59.8), the United States (44.5), Germany (19.9), India (16.0), Canada (12.0), Australia (11.4), Mexico (8.4), and Brazil (6.9). China was the largest salt-producing nation, representing about 23.3% of total world output. Canada's share was 4.7% of world production.

Preliminary 2008 Canadian data (Table 2, Figure 1) indicate salt production by the following methods: 92.3% was mined rock, 6.4% was fine vacuum, and 1.3% was brine and salt recovered in chemical operations. Production came from major rock salt mines in Ontario, Quebec, and New Brunswick, and from vacuum pan refineries in Alberta, Saskatchewan, Ontario, New Brunswick, and Nova Scotia. Over three-quarters of this production was rock salt, used primarily for highway de-icing.

Two major methods are used to obtain salt from Canada's deposits: underground room-and-pillar mining and brining. Recovery as a co-product of potash mining is also practised. The most important Canadian producers are described below (refer also to Table 4).

In Nova Scotia, The Canadian Salt Company Limited operates an underground rock salt mine at Pugwash in Cumberland County. Most of the salt arising from this mine is used

Figure 1
Canadian Salt Statistics and Trends, 1988-2008



Source: Natural Resources Canada.
(p) Preliminary.

for snow and ice control. The company also operates an evaporated salt plant where saturated brine is fed to a quadruple-effect vacuum pan; the brine solution is evaporated to produce high-quality salt crystals for use in the chemical and food industries.

Sifto Canada Inc. (a subsidiary of Compass Minerals Group Inc.) has a brining operation at Amherst, Nova Scotia. Its vapour re-compression process produces an unequaled salt purity in North America and its evaporated salt products are sold for table salt, fisheries, and water conditioning. This operation is one of the newest, most modern evaporation plants on the continent.

In New Brunswick, Potash Corporation of Saskatchewan Inc. (New Brunswick Division) produces potash and salt at its underground mine near Sussex. It extracts salt and sells it mainly to the United States and eastern Canada. It also pumps brine back to the surface for re-use. This brine is produced from the clay slimes, and excess brine slurries from the processing plant are piped underground as backfill where rock salt has been extracted.

In Quebec, Seleine Mines Division (a subsidiary of The Canadian Salt Company Limited, owned by Rohm and Haas Company of Philadelphia, Pennsylvania, United States) is the only operating salt producer. Located on the Magdalen Islands in the Gulf of St. Lawrence, it produces de-icing salt for markets in Quebec and the eastern United States.

Junex inc., an oil and gas exploration company, discovered a natural brine zone while drilling for gas in Bécancour. In 2001, Junex created Junex Solnat, which operates two natural brine well operations. Its natural brine is sold as a dust control agent for dirt roads (i.e., suppressor) and for ice removal products.

In Ontario, Sifto Canada Inc. operates an underground rock salt mine in Goderich Harbour on the shores of Lake Huron. It also operates an evaporating plant for brine production on the escarpment of the Maitland River. The products serve the home water softeners, packaged icemelts, agricultural salts, food processing, table salts, and industrial salts markets. Compass Minerals International Inc. of Overland Park, Kansas, announced a two-phased plan to increase its rock salt production capacity in Goderich. By opening a new mining panel, annual capacity will increase by approximately 750 000 short tons (st), resulting in a total mine capacity of 7.25 million st/y in 2008, compared to its previous capacity of 6.5 million st/y. Phase 2 will add another 1 million st of annual capacity and is scheduled to be fully available in 2010.

More commonly recognized under the leading consumer brand name of "Windsor," The Canadian Salt Company Limited is headquartered in Pointe-Claire, Quebec. It produces both rock salt from the Ojibway underground mine and vacuum salt from brine wells near Windsor. Salt prod-

ucts include road de-icing salt and water softening, agricultural, and chemical fine salt.

In Saskatchewan, Sifto Canada Inc. operates a brining operation near Unity for the production of fine vacuum pan salt, which is used for water softening, for agriculture, in food processing, and for the production of some de-icing salt for local use.

The Canadian Salt Company Limited at Belle-Plaine produces evaporated salt from by-product brines sourced from an adjacent potash solution mine operated by The Mosaic Company (an amalgamation of IMC Global Inc. and Cargill Crop Nutrition). Most of the production goes towards water softening; other uses are for agriculture, food processing, and ice control.

NSC Minerals Inc. is a leading supplier of industrial mineral products specializing in salt mineral crystals. It produces coarse and fine salt products from potash tailings. The head office for NSC Minerals Inc. is located in Saskatoon. It has two modern operating plants with a total daily production capacity in excess of 6000 t located at Rocanville and Vanscoy, Saskatchewan. The Rocanville plant is located in southeastern Saskatchewan near the Manitoba border and the Vanscoy plant is located in central Saskatchewan approximately 20 miles southwest of Saskatoon. Products are used for a variety of applications such as highway de-icing, livestock feed supplements, hide curing, drilling muds, water softening, road stabilization, and industrial applications.

In Alberta, The Canadian Salt Company Limited at Lindberg produces fine vacuum pan salt that is also used for water softening, agriculture, and food processing; the company also produces some de-icing salt for local use.

Other companies known to produce salt (mainly brine) are as follows:

In Saskatchewan, Mosaic Potash Esterhazy Limited Partnership (formerly IMC Esterhazy Canada Limited Partnership) supplies by-product rock salt from its potash operation at Esterhazy to Kayway Salt, which distributes it locally for road de-icing. Saskatoon Chemicals ("SaskChem," a division of Sterling Chemicals Holdings, Inc.) produces brines from wells near Saskatoon for the manufacture of caustic soda, chlorine, and sodium chlorate to be used internally for its pulp chemicals operations.

In Alberta, Dow Chemical Canada Inc. at Fort Saskatchewan near Edmonton extracts salt brines for the manufacture of chlor-alkali. Nexen Inc. (formerly Canadian Occidental Petroleum Ltd. [Canadian Oxy Ltd.]) and Albchem Industries Ltd. operate solution mines near Bruderheim. They produce sodium chlorate using feed from the large and very pure Upper Lotsberg salt deposit. Their product is mostly used for pulp bleaching in the Prairie provinces and western Canada. Ward Chemical Inc. produces calcium chloride from its natural source brine at Calling Lake.

METHODS OF RECOVERY AND APPLICATIONS

Information on methods of recovery and salt applications is available in previous editions of this salt review, available on the Internet at www.nrcan-rncan.gc.ca/mms-smm/busi-indu/cmy-amc/com-eng.htm.

PRICES

Salt has unique production, processing, and packaging factors that determine its selling price. The price of salt depends on the type of salt, location, product form, and type of sale. 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 form because mining and processing costs are minimal. Vacuum pan salt is the most expensive because of the higher energy costs involved in processing and the high purity of the product.

Due to the unavailability of prices from Canada's salt industry, the following price examples from other sources are provided. The February 2009 edition of *Industrial Minerals* (IM) magazine reported that salt prices (ground rock salt, 15-20 short ton lots, average price delivered U.K.) were in the range of £20-£30 (converted: C\$35.39-\$53.05). A further price breakdown comparison for North America can be found in Table 8 of the USGS's salt review, available on the Internet at <http://minerals.usgs.gov/minerals/pubs/commodity/salt/myb1-2007-salt.pdf>.

ENVIRONMENTAL ISSUES

The effects of salt-spreading on the environment depend on a variety of factors such as weather conditions, road characteristics, traffic loads, winter maintenance methods, and local topography. Environmental effects may include adverse impacts on plant growth and crop productivity in the immediate vicinity of highways, as well as higher salinity levels in streams and groundwater systems. Because of its low price, de-icing salt is the favoured de-icing agent.

Although the benefits of de-icing agents were recognized by the Environment Minister's Expert Advisory Panel on the Second Priority Substances List, the Panel recommended that they be assessed for potential impact on the environment but that "any measures developed as a result of the assessment must never compromise human safety." The overall conclusion of Environment Canada's *Canadian Environmental Protection Act, 1999* (CEPA 1999) report entitled *Priority Substances List Assessment Report – Road Salts* is as follows: "Based on the available data . . . road salts that contain inorganic chloride salts with or without ferrocyanide salts be considered 'CEPA toxic' . . . as defined under paragraphs 64(a) and (b) of CEPA 1999."

In April 2004, Environment Canada issued a *Code of Practice for the Environmental Management of Road Salts*. The Code applies to any organization that uses more than 500 t of road salts per year. These organizations are obliged to prepare and implement a salt management plan that contains best management practices to protect the environment from the negative impacts of road salts. Environment Canada will review the effectiveness of the Code after five years (due in 2010) and decide whether further steps are required to protect the environment.

WORLD OUTLOOK¹

The economic downturn will not have a significant impact on the salt production industry.

The principal driver behind the increased production has been growing demand from the Chinese chemical industry and, to a lesser extent, from population growth. Over the coming four to five years, global demand is expected to grow at an average of 3%/y to reach over 300 Mt in 2012.

In common with many other parts of the chemical mineral sector, rationalization and restructuring of the salt industry have continued. If the Chinese industry is considered as one enterprise, nine companies control roughly one third of global production capacity. The leading four salt-producing companies are: China National Salt Industry Corp. (18.7 Mt/y), K+S Group (16.6 Mt/y), Cargill Group Nutrition (14.0 Mt/y), and Compass Minerals Group Inc. (13.7 Mt/y).

The chlor-alkali industry is a significant consumer of salt. Salt is used in an electrolyzing solution to produce chlorine and caustic soda. During the period 2000-2006, chlorine production in China increased by roughly 7 Mt/y. A further 9 Mt/y is forecast to come on stream globally by 2012, of which 8.1 Mt/y is expected to be produced in China, stimulating strong demand for the use of salt.

The consumption of dietary salt is likely to grow in line with world and regional populations. The largest increases are expected in Asia and Africa where the largest growth in food consumption is projected.

¹ Source: Roskill's web site (www.roskill.com), report on salt.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 58. (2) Information in this review was current as of April 30, 2009. (3) This and other reviews, including previous editions, are available on the Internet at www.nrcan-rncan.gc.ca/mms-smm/busi-indu/cmy-amc/com-eng.htm.

NOTE TO READERS

The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

TARIFFS

| Item No. | Description | Canada | | | United States | EU | Japan |
|----------|--|-----------|------|------|---------------|-----------------------|-----------------|
| | | MFN | GPT | USA | Canada | Conventional Rate (1) | WTO (2) |
| 2501 | Salt (including table salt and denatured salt) and pure sodium chloride, whether or not in aqueous solution or containing added anti-caking or free-flowing agents; seawater | Free-2.5% | Free | Free | Free | Free-£2.6/1000 kg | Free-0.5 yen/kg |

Sources: Canadian *Customs Tariff*, effective January 2009, Canada Border Services Agency; *Harmonized Tariff Schedule of the United States*, 2009; *Official Journal of the European Union* (Tariff Information), September 19, 2008 edition; *Customs Tariff Schedules of Japan*, 2009.

(1) The customs duties applicable to imported goods originating in countries that are Contracting Parties to the General Agreement on Tariffs and Trade or with which the European Community has concluded agreements containing the most-favoured-nation tariff clause shall be the conventional duties shown in column 3 of the Schedule of Duties. (2) WTO rate is shown; lower tariff rates may apply circumstantially.

TABLE 1. CANADA, SALT SHIPMENTS AND TRADE, 2006-08

| Item No. | 2006 | | 2007 | | 2008 (p) | |
|--|---|---------|------------|------------|------------|---------|
| | (tonnes) | (\$000) | (tonnes) | (\$000) | (tonnes) | (\$000) |
| SHIPMENTS | | | | | | |
| By type | | | | | | |
| | 888 073 | 104 897 | 889 503 | 108 013 | 912 489 | 112 582 |
| Fine vacuum salt | | | | | | |
| Mined rock salt | 12 453 922 | 344 644 | 10 807 936 | 328 483 | 13 075 410 | 419 392 |
| Salt content of brines used or shipped | 1 117 815 | 11 181 | 272 205 | 6 349 | 180 148 | 5 806 |
| Total | 14 459 810 | 460 722 | 11 969 644 | 442 845 | 14 168 047 | 537 780 |
| By province | | | | | | |
| Nova Scotia | x | x | x | x | x | x |
| New Brunswick | x | x | x | x | x | x |
| Quebec | x | x | x | x | x | x |
| Ontario | 9 185 124 | 270 604 | 7 652 398 | 259 215 | 9 512 757 | 326 502 |
| Manitoba | x | x | x | x | x | x |
| Saskatchewan | 1 183 828 | 52 326 | 1 162 165 | 53 266 | 1 257 241 | 55 632 |
| Alberta | 1 116 375 | 21 417 | 281 409 | 17 023 996 | 180 387 | 17 928 |
| Total | 14 459 810 | 460 722 | 11 969 644 | 442 845 | 14 168 047 | 537 780 |
| EXPORTS (1) | | | | | | |
| 2501.00 | Salt (including table salt and natural salt) and pure sodium chloride whether or not in aqueous solution or containing added anti-caking or free-flowing agents; seawater | | | | | |
| | 4 120 657 | 84 969 | 4 358 208 | 87 390 | 4 761 033 | 120 708 |
| United States | 418 | 97 | 447 | 104 | 21 757 | 152 |
| Costa Rica | 912 | 115 | 967 | 134 | 952 | 130 |
| Barbados | 777 | 6 | 297 | 34 | 413 | 54 |
| Saint Pierre and Miquelon | 566 | 94 | 502 | 83 | 287 | 49 |
| France | 149 | 30 | 158 | 31 | 164 | 33 |
| Jamaica | 132 | 27 | 44 | 33 | 67 | 15 |
| South Korea | 183 | 38 | 76 | 15 | 64 | 13 |
| Belgium | 104 | 28 | 78 | 21 | 59 | 12 |
| Philippines | 96 | 19 | 123 | 25 | 49 | 10 |
| Saint Kitts and Nevis | 912 | 105 | 285 | 57 | 166 | 30 |
| Other countries | | | | | | |
| Total exports | 4 124 906 | 85 528 | 4 361 185 | 87 927 | 4 785 011 | 121 206 |

TABLE 1 (cont'd)

| Item No. | 2006 | | 2007 | | 2008 (p) | | |
|---|--|------------------|---------------|------------------|---------------|------------------|---------------|
| | (tonnes) | (\$000) | (tonnes) | (\$000) | (tonnes) | (\$000) | |
| IMPORTS (1) | | | | | | | |
| 2501.00 | Salt (including table salt and natural salt) and pure sodium chloride, whether or not in aqueous solution or containing added anti-caking or free-flowing agents; seawater | | | | | | |
| | United States | 1 065 535 | 41 118 | 739 217 | 38 631 | 1 133 642 | 43 369 |
| | Mexico | 398 666 | 6 513 | 350 209 | 6 608 | 414 875 | 9 938 |
| | Chile | 70 839 | 995 | 35 914 | 7 095 | 146 363 | 8 500 |
| | France | 25 722 | 2 551 | 12 124 | 2 968 | 36 026 | 3 587 |
| | Bahamas | 16 816 | 577 | 23 367 | 816 | 35 660 | 1 386 |
| | Brazil | 37 502 | 1 779 | 52 277 | 2 944 | 43 754 | 1 252 |
| | United Kingdom | 152 | 99 | 168 | 140 | 130 | 843 |
| | Ireland | 15 | 525 | 7 | 345 | 34 | 761 |
| | Greece | 404 | 345 | 1 138 | 341 | 548 | 503 |
| | China | 2 405 | 197 | 1 864 | 325 | 1 436 | 404 |
| | Italy | 1 405 | 321 | 1 458 | 426 | 1 900 | 362 |
| | Pakistan | 888 | 296 | 736 | 308 | 872 | 311 |
| | Israel | 1 540 | 284 | 1 336 | 231 | 1 699 | 295 |
| | South Korea | 1 858 | 235 | 1 198 | 201 | 1 722 | 243 |
| | Spain | 19 | 40 | 20 | 34 | 7 370 | 222 |
| | Germany | 67 | 100 | 38 | 89 | 94 | 217 |
| | Canada | 1 133 | 48 | 2 463 | 91 | 5 300 | 206 |
| | Peru | 4 | 1 | .. | .. | 19 007 | 191 |
| | Netherlands | 157 | 68 | 1 | 2 | 152 | 156 |
| | South Africa | 234 | 20 | 8 | 41 | 519 | 152 |
| | Portugal | 765 | 95 | 774 | 116 | 392 | 142 |
| | India | 1 008 | 49 | 100 | 59 | 3 305 | 105 |
| | Australia | 57 | 144 | 12 | 53 | 22 | 101 |
| | Other countries | 742 | 230 | 1 004 | 367 | 4 837 | 377 |
| | Total imports | 1 627 933 | 56 630 | 1 225 433 | 62 231 | 1 859 659 | 73 623 |
| Imports by province or territory of clearance | | | | | | | |
| | Newfoundland and Labrador | 59 127 | 1 102 | 23 370 | 828 | 35 664 | 1 327 |
| | Prince Edward Island | — | — | — | — | — | — |
| | Nova Scotia | .. | 3 | 16 | 1 | 11 461 | 214 |
| | New Brunswick | 172 | 93 | 190 | 64 | 195 | 101 |
| | Quebec | 169 453 | 7 615 | 70 033 | 7 819 | 210 103 | 11 304 |
| | Ontario | 893 753 | 34 424 | 698 617 | 32 761 | 992 841 | 39 227 |
| | Manitoba | 4 274 | 655 | 3 428 | 653 | 1 971 | 581 |
| | Saskatchewan | 5 749 | 596 | 3 290 | 440 | 1 081 | 434 |
| | Alberta | 8 920 | 1 206 | 6 552 | 1 091 | 51 351 | 884 |
| | British Columbia | 486 485 | 10 940 | 419 937 | 18 579 | 554 992 | 19 555 |
| | Yukon | .. | .. | — | — | — | — |
| | Northwest Territories | — | — | — | — | — | — |
| | Nunavut | — | — | — | — | — | — |
| | Total | 1 627 933 | 56 634 | 1 225 433 | 62 234 | 1 859 659 | 73 626 |

Sources: Natural Resources Canada; Statistics Canada.

— Nil; .. Not available; ... Amount too small to be expressed; (p) Preliminary; x Confidential.

(1) Includes table salt, pure sodium chloride, and seawater salt.

Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, SALT SHIPMENTS AND TRADE, HISTORICAL, SALT AND SODIUM COMPOUNDS, 1988-2008

| | Producers' Shipments | | | Total | Imports | Exports |
|----------|----------------------|-------------|---|------------|-----------|-----------|
| | Mined Rock | Fine Vacuum | In Brine and Recovered in Chemical Operations | | | |
| | (tonnes) | | | | | |
| 1988 | 7 126 762 | 783 368 | 2 777 050 | 10 687 180 | 1 202 220 | 3 030 124 |
| 1989 | 7 548 732 | 821 284 | 2 788 395 | 11 158 411 | 2 360 433 | 2 137 321 |
| 1990 | 7 704 499 | 778 428 | 2 708 458 | 11 191 385 | 2 095 324 | 1 897 816 |
| 1991 | 8 615 755 | 799 563 | 2 455 541 | 11 870 859 | 1 202 879 | 2 783 021 |
| 1992 | 7 912 989 | 770 370 | 2 404 667 | 11 088 026 | 1 041 424 | 2 650 921 |
| 1993 | 8 073 435 | 817 859 | 2 101 711 | 10 993 005 | 1 051 029 | 3 079 298 |
| 1994 | 9 446 002 | 822 181 | 1 975 704 | 12 243 887 | 940 130 | 3 638 674 |
| 1995 | 8 077 661 | 850 676 | 2 029 047 | 10 957 384 | 1 294 994 | 2 986 802 |
| 1996 | 9 499 189 | 853 858 | 1 895 430 | 12 248 477 | 1 137 603 | 3 816 788 |
| 1997 | 10 923 966 | 863 112 | 1 709 778 | 13 496 856 | 1 262 836 | 3 634 009 |
| 1998 | 10 517 641 | 834 944 | 1 681 710 | 13 034 295 | 977 943 | 4 177 880 |
| 1999 | 10 004 167 | 823 983 | 1 857 745 | 12 685 895 | 1 375 143 | 3 808 093 |
| 2000 | 9 458 260 | 827 630 | 1 878 179 | 12 164 069 | 1 141 063 | 3 475 755 |
| 2001 | 11 528 499 | 844 719 | 1 351 761 | 13 724 979 | 1 644 424 | 4 616 739 |
| 2002 | 10 581 246 | 870 370 | 1 284 861 | 12 736 477 | 1 375 136 | 3 689 799 |
| 2003 | 11 739 364 | 905 096 | 1 073 362 | 13 717 822 | 969 125 | 4 196 741 |
| 2004 | 12 000 704 | 923 924 | 1 171 660 | 14 096 288 | 2 148 674 | 4 247 344 |
| 2005 | 11 404 899 | 925 437 | 1 132 689 | 13 463 025 | 1 295 008 | 3 984 162 |
| 2006 | 12 453 922 | 888 073 | 1 117 815 | 14 459 810 | 1 627 933 | 4 124 906 |
| 2007 | 10 807 936 | 889 503 | 272 205 | 11 969 644 | 1 225 433 | 4 361 185 |
| 2008 (p) | 13 075 410 | 912 489 | 180 148 | 14 168 047 | 1 859 659 | 4 785 011 |

Sources: Natural Resources Canada; Statistics Canada.

(p) Preliminary.

TABLE 3. WORLD SALT PRODUCTION, 1999-2007

| | 1999 | 2000 | 2001 | 2002 | 2003 (r) | 2004 (r) | 2005 (r) | 2006 (r) | 2007 (p) |
|---------------------|--------------|---------|---------|---------|----------|----------|----------|----------|----------|
| | (000 tonnes) | | | | | | | | |
| China | 28 124 | 31 280 | 34 105 | 36 024 | 32 424 | 37 101 | 46 610 | 56 630 | 59 760 |
| United States (1) | 45 000 | 45 600 | 44 800 | 40 300 | 43 700 | 46 500 | 45 200 | 44 400 | 44 500 |
| Germany | 15 700 | 15 700 | 14 343 | 15 736 | 16 424 | 18 838 | 19 332 | 19 846 | 19 900 |
| India | 14 453 | 14 453 | 14 503 | 14 503 | 15 003 | 15 003 | 15 003 | 15 500 | 16 000 |
| Canada (2) | 12 686 | 12 164 | 13 725 | 12 736 | 13 718 | 14 096 | 13 463 | 14 460 | 11 970 |
| Australia | 9 888 | 8 778 | 9 536 | 9 961 | 10 256 | 11 088 | 12 444 | 11 363 | 11 440 |
| Mexico | 8 236 | 8 884 | 8 501 | 7 802 | 7 547 | 8 566 | 9 508 | 8 371 | 8 400 |
| Brazil | 5 958 | 6 074 | 5 578 | 6 109 | 6 564 | 6 648 | 7 079 | 6 746 | 6 930 |
| France | 7 000 | 7 000 | 7 000 | 6 400 | 6 673 | 6 910 | 6 730 | 8 718 | 6 140 |
| United Kingdom | 5 800 | 5 800 | 5 800 | 5 700 | 5 900 | 5 800 | 5 800 | 5 800 | 5 800 |
| Ukraine | 2 185 | 2 287 | 2 300 | 2 350 | 3 863 | 4 393 | 4 811 | 5 996 | 5 548 |
| Netherlands | 5 000 | 5 000 | 5 000 | 5 000 | 5 000 | 5 000 | 5 000 | 5 000 | 5 000 |
| Spain | 3 200 | 3 200 | 3 200 | 3 894 | 3 963 | 3 993 | 4 550 | 4 550 | 4 550 |
| Chile | 6 074 | 5 083 | 5 989 | 3 503 | 6 213 | 4 939 | 6 068 | 4 580 | 4 404 |
| Poland | 1 623 | 1 576 | 1 484 | 3 558 | 4 660 | 5 142 | 4 190 | 4 955 | 4 391 |
| Other countries (r) | 64 626 | 68 121 | 70 136 | 27 938 | 28 227 | 27 795 | 30 235 | 28 829 | 42 267 |
| Total (3) | 207 000 | 209 000 | 214 000 | 214 000 | 225 000 | 236 000 | 250 000 | 262 000 | 257 000 |

Sources: Natural Resources Canada; U.S. Geological Survey.

(p) Preliminary; (r) Revised.

(1) Excludes Puerto Rico. (2) The U.S. Geological Survey is the source for all data, excluding data for Canada, for which the source is Natural Resources Canada. (3) Totals only were revised.

Note: Numbers may not add to totals due to rounding.

TABLE 4. CANADIAN SALT PRODUCERS, 2007 AND 2008

| Company | Location/ Initial Production | Mill/Plant Capacity | Remarks |
|---|---|------------------------|--|
| | | (t/d) | |
| ERCO Worldwide | Hargrave Facility, Man./2002 | 65 t/y | Brining to produce sodium chlorate |
| Canexus Limited | Bruderheim, Alta./1991 | 109 | Brining to produce sodium chlorate (salt brine) |
| Canadian Salt Company Limited, The | Pugwash, N.S./1959 | 7 800 | Rock salt |
| | Pugwash, N.S./1963 | 7 800 | Brine made from mined rock salt used to produce fine evaporated salt (rock salt) |
| | Mine Seleine, Iles-de-la-Madeleine, Que./1982 | 4 800 | Rock salt |
| | Ojibway, Ont./1955 | 10 500 | Salt graded and prepared for markets (rock salt) |
| | Windsor, Ont./1892 | 750 | Evaporated salt |
| | Belle-Plaine, Sask./1969 | 726 | Plant uses sodium chloride brines produced at the nearby potash solution mine of IMC Kalium Canada Ltd. (evaporated salt) |
| | Lindbergh, Alta./1968 | 400 | Produces coarse and fine salt (evaporated salt) |
| Mosaic Potash Esterhazy | K1 and K2 mine, Esterhazy, Sask./1962 | 180 t/y | By-product rock salt from potash mine (standard, coarse, and granular grades) |
| Junex Inc. | Bécancour, Que. | .. | Natural brine for de-icing and dust control |
| NSC Minerals Inc. | Rocanville, Sask./1990 | 200 t/y | Produces coarse and fine products (rock salt) |
| | Vanscoy, Sask./1988 | 300 t/y | Produces coarse and fine products (rock salt) |
| Potash Corporation of Saskatchewan Inc. | Sussex, N.B./1983 | 700 | Three grades of muriate of potash (KCl) are produced from a flotation circuit and a crystallizer circuit (salt) |
| Sterling Pulp Chemicals (Sask) Ltd. | Saskatoon, Sask./1979 | 130 | Primarily a manufacturer of pulp and water treatment chemicals; brining to produce caustic soda, chlorine, and sodium chlorate |
| Sifto Canada Corp. | Amherst, N.S./1947 | 310 | Brining for vacuum pan evaporation (evaporated salt) |
| | Goderich, Ont./1959 | 24 943 | Rock salt mining |
| | Goderich, Ont./1872 | 390 | Brining for vacuum pan evaporation (evaporated salt) |
| | Unity, Sask./1949 | 454 | Brining for vacuum pan evaporation (evaporated salt) |
| Rio Petro Ltd. | Airdrie, Alta. | .. | Salt content of brine |
| Ward Chemical Inc. | Edmonton, Alta. | 1 200 | Calcium chloride |

Sources: Natural Resources Canada, company surveys.

.. Not available.