Salt

Patrick Morel-à-l'Huissier

The author is with the Minerals and Metals Sector, Natural Resources Canada.
Telephone Michel Prud'homme at (613) 992-3733

CANADIAN PRODUCTION AND DEVELOPMENTS

In 1995, Canadian salt production was estimated at 10.7 Mt, a 13% decrease over 1994. Most of this decrease was due to the indeterminate shut-down of the Quebec mine located in the Magdalen Islands, which was prompted by water infiltration. However, some of the decrease in rock salt production was also a consequence of the relatively mild winter conditions experienced during the 1994/95 winter. In contrast, both fine vacuum pan salt and brining remained stable. Estimated Canadian shipments of all types of salt in 1995 were 10.7 Mt, a 12% decrease over 1994 shipments of 12.24 Mt. In 1995, shipments from Ontario accounted for 62% of all shipments, an increase in the share but a 9.3% decrease in volume over 1994 shipments. Rock salt shipments accounted for 73% of total shipments, followed by salt in brines (19%) and evaporated salt (8%). The average unit value of salt shipments was estimated at $24.87/t, a 1% increase over that of 1994. In 1995, rock salt mines operated at 80% of capacity; captive brining plants and evaporated salt facilities operated at 90% and 84%, respectively. Salt operations overall ran at an average rate of 82% of capacity, compared to 88% in 1994. Sales of salt products for de-icing purposes were weak all across the country in the second half of the 1994/95 winter due to mild weather. However, sales of salt products for de-icing purposes were better across the country due to the early 1995/96 winter that was accompanied by heavy snowfalls, particularly in eastern Canada.

The year 1995 was relatively good for the Canadian pulp and paper industry, which is one of the largest end users for chloralkali. Pulp mills operated at 95% of capacity in 1995, compared to 94% in 1994, and they are expected to maintain the same operating rate in 1996. Canadian shipments and exports of pulp, paper and paperboard were comparable to those of 1994.

Sodium chlorate is considered to be the primary substitute for chlorine bleaching in pulp mills as it is the feedstock for the production of chlorine dioxide. No new sodium chlorate plants came on stream in 1995. However, CXY Chemicals Canada Ltd. Partnership has announced a 30% production increase at its facility in Bruderheim. Canadian production of sodium chlorate was up by about 10% over the previous year, and is expected to experience similar growth in 1996.

Atlantic Region

Salt production in the Atlantic provinces was from an underground rock salt mine at Pugwash, Nova Scotia; an underground potash and salt mine at Sussex, New Brunswick; and a brining operation near Nappan, Nova Scotia.

In Nova Scotia, The Canadian Salt Company Limited operates an underground rock salt mine at Pugwash in Cumberland County with a rated capacity of approximately 1.2 Mt/y. Most of the salt from this mine is used for snow and ice control. At the evaporated salt plant, saturated brine is fed to a quadruple-effect vacuum pan, rated at 13 t/h, where brine solution is evaporated to produce high-quality salt crystals for use in the chemical and food industries. The Canadian Salt Company Limited is no longer bagging solar salt and, as a result, has sold its bagging operation at North Sidney. The Shelbourne site, which was also used for bagging, is now handling bulk shipments.

In New Brunswick, Potash Corporation of Saskatchewan Inc. (New Brunswick Division) produced potash and salt at its underground mine near Sussex. Salt is extracted at a rate of about 585 000 t/y and is sold mainly to the eastern United States and eastern Canada under a sales contract with Akzo Salt Limited. Reserves are estimated to be large enough to operate for as long as potash is extracted, which is at least 25 years. Over the past two years, the mine has been able to increase its production capacity through productivity improvement. In 1995, about 95% of production was used in road de-icing and the remainder for chemical use. The mine is now using the integrated method of utilizing salt tailings underground as fill to support the salt and potash mining operation. Approximately 1.75 Mt of salt waste from the potash operation and rock salt screen rejects are sent directly to active cut-and-fill potash stopes to be

used as backfill. Clay slimes and excess brine slurries from the processing plant are also piped underground to be discharged into large cavities created by the extraction of rock salt. After the solids have settled, the clear brine solution is re-pumped to the surface for re-use. The entire operation results in a closed circuit or "zero effluent" system.

Sifto Canada Inc., a division of North American Salt Co., has a brining operation at Nappan in Cumberland County, Nova Scotia. Evaporated salt products are sold for table salt, fisheries, and water conditioning.

Quebec

There is only one operating salt producer in Quebec, Seleine Mines Inc., located on the Magdalen Islands. Seleine Mines Inc. is owned by The Canadian Salt Company Limited. In 1995, this operation was closed down for more than seven months as a result of water infiltration. The mine started to develop a water leak in late April and, in early May, the leak became so significant that the company was forced to shut down its operation. In an effort to control the leak, the shaft was backfilled up to the 60-m level. A plug was established on top of the backfill. External and internal grouting has been successful at controlling the leak. The company is optimistic that it will resume production in early 1997. It must be emphasized that the operating area is intact and that only the lower levels that were under development have been affected by water infiltration. Once the water is pumped out, development of these levels will resume. Each operating level contains reserves of about 8 Mt, which are sufficient to last about five years. All of the inventory was sold in 1995.

Ontario

In 1995, salt was produced from two underground rock salt mines, Goderich and Ojibway, and from brining operations at Goderich, Windsor and Amherstburg. Salt is extracted from the Salina formation.

At Goderich, Sifto Canada Inc. operates an underground rock salt mine. Mining is currently conducted approximately 537 m below the surface, 2.5 km off the shore of Lake Huron. Reserves are estimated to be about 240 Mt and the mine has an annual capacity of 3.7 Mt of salt products. The mine has now completed its conversion to the bench mining technique. This conversion is responsible for the increased capacity observed over the past two years. Sifto's salt is marketed mainly for ice control and is sold primarily in eastern Canada, the north-central United States (Great Lakes Basin), and regions accessible through the Mississippi River system. Salt produced at Goderich is also used by the chemical and water treatment industries. Evaporated salt is produced at the Sifto brining operation located near Goderich and is used mainly for the water-softening market.

The Canadian Salt Company Limited produced both rock salt from the Ojibway underground mine and vacuum salt products from brine wells near Windsor. The mine capacity is 2.5 Mt/y and current estimated reserves are 100 Mt. Rock salt is extracted using room-and-pillar mining methods from a 7.5-m unit of the Salina formation about 297 m below the surface. Brine is pumped from the 427-m and 457-m levels. Production is now taking place in the southwest portion of the 297-m level within about 600 m of the shaft. A vapor recompression system was added in late 1995. Salt products include de-icing road salt (accounting for two thirds of production), and water softening, agricultural and chemical fine salt. The main markets are Canada and the midwestern United States for all salt products except chemical fine salt, which is marketed in Quebec for the manufacture of caustic soda and chlorine. In 1994, The Canadian Salt Company Limited acquired the mineral rights to Fighting Island in the Detroit River, and it therefore now has sufficient reserves for at least 40 years.

In the vicinity of Amherstburg, General Chemical Canada Ltd. operates a brining operation for the manufacture of sodium carbonate and by-product calcium chloride. Because of the important quantities of sodium chloride resulting from the calcium chloride stream, the company is currently assessing the possibility of profiting from this by-product sodium chloride.

Prairie Provinces

In Saskatchewan, four companies produced salt from the Middle Devonian Prairies formation in 1995. International Minerals & Chemical Corporation (Canada) Limited (IMCC) supplied by-product rock salt from its potash operation at Esterhazy to Kayway Salt, who is distributing it locally for road de-icing. Kayway Salt is presently considering the U.S. market, especially North Dakota, Wisconsin and Montana. Kayway Salt is planning to add another warehouse in 1996. Sifto Canada Inc. operated a brining operation near Unity for the production of fine vacuum pan salt. A new brine well was added in 1995. Since the closure of its fused salt plant, the company has adopted the compaction method to produce water softener salt. Other uses of its salt include for agriculture, in food processing, and some de-icing salt for local use. The Canadian Salt Company Limited at Belle-Plaine produced evaporated salt from by-product brines sourced from an adjacent potash solution mine operated by Kalium Chemicals, a division of Kalium Canada, Ltd. Most of the production goes towards water softening; other uses include for agriculture and in food processing and ice control. Saskatoon Chemicals, a division of Weyerhaeuser Canada Ltd., produced brines from wells near Saskatoon for the manufacture of caustic soda, chlorine and sodium chlorate to be used internally in its pulp and paper operations.

Nusalt Corporation processed salt-rich potash tailings from Potash Corporation of Saskatchewan's Rocanville operation. The potash tailings are dried and bulk delivered to local distributors for road de-icing. Other applications are for cattle feed and water softening. Nusalt is currently seeking new markets, such as the United States.

Central Canada Potash Limited began salt production in September 1992. Salt is recovered from its potash tailings and the reported capacity is 328 000 t/y. The main product is de-icing salt, which accounts for 80% of production; the remaining 20% is for general use. Products are mostly sold locally in British Columbia, Alberta and Saskatchewan. The company is now moving to the commercial market where its products can be found under the Canadian registered trademark "Sabre." Salt is bagged at three locations. The company is seeking new markets in both Canada and the United States.

In Alberta, four producers operated brining operations. At Fort Saskatchewan near Edmonton, Dow Chemical Canada Inc. extracted salt brines for the manufacture of chloralkali and, at Lindberg, The Canadian Salt Company Limited produced fine vacuum pan salt. Near Bruderheim, two companies, CXY Chemicals Canada Ltd. Partnership and Albchem Industries, operated solution mines to produce sodium chlorate used mostly for pulp bleaching in the prairie provinces and western Canada. CXY Chemicals Canada Ltd. Partnership (formerly known as Canadian Oxy Ltd.) is planning a 30% expansion of its chlorate production facility to be completed by mid-1996. This increase will be achieved by increasing the capacity of the equipment.

British Columbia

There was no production of salt in this province where three companies operated four chloralkali plants. These operations used solar salt imported from Mexico, the United States and Chile.

CONSUMPTION

In Canada, the apparent consumption of salt has averaged 9.0 Mt/y since the mid-1980s, a 30% increase compared to the early 1980s. In 1994, the apparent consumption of salt in Canada was estimated at 9.5 Mt, a 6.3% increase over 1993. In 1994, imports, mainly in British Columbia, Ontario and Quebec, accounted for about 9.8% of total domestic consumption. In 1995, the apparent consumption is estimated at 9.2 Mt, a 3.6% decrease over 1994. Chemical and de-icing uses accounted for between 90% and 95% of Canadian consumption, with the remainder being used for water conditioning, food processing, fisheries, and other industrial uses. Most of the salt used as a de-icing agent is consumed in Ontario, Quebec and Atlantic Canada. The average yearly consumption of salt in Canada for ice and snow control ranges between 3.2 and 4.5 Mt.

Some 60% of world salt consumption is as a chemical raw material, followed by table salt (20%) and road de-icing salt (10%); the remaining 10% is used in animal feed and water treatment. The consumption pattern differs in North America where the chemical industry consumes about 56% of total production, followed by highway usage (24%) and the food industry (7%).

Chloralkali and Related Uses

The main news for the Canadian chloralkali industry is the closure of the ICI Canada Inc. plant at Cornwall, Ontario. The closure, which "is the result of technological, economic and environmental factors," was initially scheduled for the end of October 1994, but was then postponed until the end of March 1995. The plant used the old mercury cell technology and had a capacity of 38 500 t/y of caustic soda and 35 000 t/y of chlorine. The plant was 60 years old and employed 50 people. To compensate for this closure, ICI is planning to boost the capacity of its Becancour plant by about 20 000-25 000 t/y.

The industrial chemicals industry consumes salt for the manufacture of chloralkali such as caustic soda (sodium hydroxide), chlorine, and sodium chlorate. Salt for four caustic soda and chlorine plants in Canada is obtained from on-site brining and natural brines; other plants use mined rock salt or imported solar or evaporated salt. Other industrial chemicals that require significant quantities of salt include sodium bicarbonate, sodium chlorite, sodium hypochlorite, sodium carbonate (soda ash), and calcium chloride.

Chlorine, which is a major market for salt, is the principal pulp-bleaching agent responsible for the presence of traces of dioxin (2, 3, 7, 8,-TCDD (tetrachlorodibenzo-p-dioxin)) and furan (2, 3, 7, 8,-TCDF (tetrachlorodibenzo-p-furan)) in certain pulp and paper mill effluents in North America. These chlorinated compounds have been identified as carcinogenic to some animals; however, their effect in small dosages on humans is the focus of controversy.

In 1994, the release of furans and dioxins was banned in pulp mill effluents in Canada. This is further to an announcement by the Canadian government in February 1991 requiring compliance by pulp and paper mills with new amendments to regulations under the *Fisheries Act*. These amendments establish new procedures for effluents measurement and, for the first time, make **all** mills in Canada, new and old, subject to regulations governing the discharge of suspended solids and oxygen-depleting substances. To obtain an extension beyond the December 31, 1993, deadline, a company should have demonstrated that it made all reasonable efforts to comply with these regulations. An extension will be subject to

public consultation and ministerial approval. No extensions will be granted after December 31, 1995. Several mills have asked for extensions.

The degree to which dioxins present a toxicity hazard is currently the focus of debate in the United States, Canada and Europe. In this regard, the U.S. Environmental Protection Agency (EPA) and the Centers for Disease Control in Atlanta have stated that there is new evidence suggesting that dioxin is not as potent a carcinogen as originally believed. However, in September 1994, the EPA released a draft of an extensive review of all available scientific information on dioxin and related compounds. In the conclusions of this draft it is stated that, "With regard to carcinogenicity, a weight-of-the-evidence evaluation suggests that dioxin and related compounds are likely to present a cancer hazard to humans," and that "based on all of the data reviewed in this reassessment and scientific inference, a picture emerges of TCDD and related compounds as potent toxicants in animals with the potential to produce a wide range of effects, some of which may be adverse, in humans at very low levels." This report has become very controversial; for example, the Committee of Applied Sciences of the French Academy of Sciences has published its own report (80 pages versus the 2000 pages published by the EPA) in which it stated that, "contrary to popular opinion, there is no evidence to suggest that dioxins and their related compounds constitute a major risk to public health." It also stated that "no fatal case of poisoning by these products has ever been reported" and that "current exposure is well below the daily acceptable dose" (set by the World Health Organization at 10 picograms/kilogram/day).

In Canada, a study by the National Water Research Institute in Burlington found that there is no link between chronic biological changes in fish and effluents from all types of kraft mills, whether using chlorine as a bleaching agent or not. However, these findings are unlikely to change policies on dioxin in Canada as another study by Environment Canada found that pulp mill effluents are toxic and will endanger human life as long as chlorine is used, even if all dioxins were to be removed.

In early 1992, the province of British Columbia issued a regulation calling for the elimination of chlorine-compound pollution from pulp mills by the year 2002. Under this regulation, adsorbable organic halides (AOX) should be reduced to 1.5 kg/t by 1995 and to zero by 2002. In 1993, the province of Ontario issued new rules for the pulp and paper industry. Under these rules, discharges of AOX should drop 40% from the current 2.5 kg/t by the end of 1995, and by a total of 68% by the end of 1999, bringing the total discharge of AOX to 0.8 kg/t. However, the Ontario regulation does not go as far as the British Columbia initiative as it does not call for the total elimination of AOX by the year 2002. Final decisions on this issue may take until the end of the decade.

In the United States, the EPA proposed a new rule to cut toxic air and water pollutants from about 350 pulp and paper mills. Under the proposed new rule, all dioxin discharges in water would be virtually eliminated. This new rule is to take effect in 1998.

Many mills in North America have continued the conversion of their bleaching process away from chlorine technology. A limit of 1.5 kg/t for AOX, which includes furans and dioxins, would require a substitution level of up to 80-90% in older mills and up to 60-70% in more recent mills.

Most 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. Although environmentalists consider sodium chlorate to be a step in the right direction in the move away from chlorine, they still would like the pulp and paper industry to adopt dioxin-free bleaches such as oxygen and hydrogen peroxide.

De-Icing

Sodium chloride, or salt, remains the primary de-icing agent. Different de-icers are used in accordance with site requirements. On streets and highways, rock salt, calcium chloride-salt mixtures, salt brines, and mechanical measures (plowing and blowing) are mostly used. On bridges, salt, sand-salt mixtures, and salt alternative methods are used; pavement heating and non-corrosive chemicals with corrosion inhibitors are under investigation. On runways and airways, non-corrosive compounds are used and comprise urea, formamide, and glycols. In residential and commercial areas, rock salt, potassium chloride (potash), calcium chloride, and various combinations of these materials with abrasives are regularly used. 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. The use of abrasives is mostly limited to highways and residential areas; a mixture of coarse sand and small crushed stone is spread to improve the skid resistance of slippery roads.

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. Research on alternatives has focused on abrasive mixes, magnesium chloride, ammonium compounds, tetrapotassium pyrophosphates, calcium magnesium acetate (CMA), sodium formate, isopropyl alcohol, ethylene glycol, and technical urea. Studies have also been conducted on non-chemical treatments, including a series of measures that are used mainly in Europe such as ice-retardant

pavement surfacing and roadway heating. 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. For many years, provincial and regional agencies in charge of road maintenance have pursued the objective of optimizing the use and selection of ice and snow control methods. Cost, operational reliability, public safety, and environmental considerations have all resulted in improvements to existing methods and better road safety and rideability.

As a result of these concerns, Environment Canada has decided to put "Road Salts" on the second Priority Substances List (PSL2) that was announced on December 16, 1995. The inclusion of road salts is the result of the recommendations outlined in the *Report of the Ministers' Expert Advisory Panel on the Second Priority Substances List under CEPA* that was issued in October 1995. In the rationale for including road salts in PSL2, while recognizing the benefits of their usage, the Panel cites "evidence of adverse local environmental effects to groundwater and to plant and animal life." Because of these consequences and the widespread use of road salts, and "their release in large volume into the Canadian environment, the panel believes that an assessment is needed to determine their ecological effects." At this stage, the list of substances grouped under road salts has not been published; however, it is clear that sodium chloride will be part of them.

Tests by the Ontario Ministry of Transportation indicate that CMA is only effective at temperatures around –6° and –7°C. Although CMA has proven to be effective and environmentally safe, its temperature limitation and its price, which is about 30 times that of salt, will continue to limit its application. In 1991, the Research and Development Branch of the Ontario Ministry of Transportation published a paper presenting the results of research on highway de-icers. Several de-icers were compared; salt was still acknowledged to be the most efficient and least expensive de-icer for use in the province of Ontario.

Other Uses

Other sectors that consume salt include water softening, food processing, and the fisheries industry, which together account for close to 5% of total salt consumption in Canada. Salt consumption in Canada for water softening is estimated at 150 000-200 000 t/y. All Canadian production is consumed in the domestic market; trade in water-conditioning salt is estimated to be small. Typical annual consumption per household in Canada ranged between 350 and 450 kg/y of salt. The bulk of the water-softening market is reported to be located in suburban and rural areas where hard water is seldom treated on a large-scale basis. Some major municipalities in western Canada, such as Regina and Calgary, use water softeners extensively as the local water carries high calcium and magnesium concentrations. Potassium chloride is also being introduced in the water treatment market as a substitute for salt. It is expected that within a few years sodium chloride and potassium chloride will share the water treatment market. Fused salt, which was a popular product for water softening, has been replaced by compacted salt pellets, nuggets and crystals; in some instances, coarse salt is used. Growth in this market is tied to housing starts and local water characteristics. New water treatment devices that do not use salt, such as electromagnetic equipment and catalytic units, have not yet been approved in Canada.

The North American salt industry is currently investigating the potential of using salt in several cosmetic and body products, a market that has grown significantly in Japan where some body shampoos can contain up to 50% salt.

TRADE

Imports of salt in 1994 were 0.94 Mt valued at $31.2 million, which in volume represented a 10.6% drop compared to 1993, but represented only a 2% decrease in value. During the first ten months of 1995, imports were estimated at 1.2 Mt valued at $33.6 million, indicating an increase for the year. In 1995, the import unit price decreased 12% to $29.61/t from $33.18/t in 1994. The origin of imports in 1994 was from 26 countries, but mainly from the United States (64%), Mexico (33%) and the Bahamas (2%), for deliveries in Ontario (42%), British Columbia (41%), Quebec (12%) and the rest of Canada (5%).

Exports of salt in 1994 were 3.6 Mt valued at $97.7 million which, when compared to 1993 figures of 3.1 Mt valued at $73.8 million, represents an increase of 18.2% in volume and 32.3% in value. In the first ten months of 1995, exports totalled 2.48 Mt valued at $64.1 million. The unit value decreased by 2.5% from $26.84/t in 1994 to $26.16/t in 1995. Exports of salt products in 1994 were to 19 countries, but principally to the United States, which accounted for 99.9%. Deliveries were shipped mainly from Ontario (65%), Quebec (27%) and Nova Scotia (6%).

WORLD PRODUCTION

The total world production of salt in 1995 was estimated at 185 Mt, representing a 3% increase over 1994. Salt is produced in numerous countries, but the bulk of the production is from about 15 countries, of which the United States is the principal producer. The United States accounted for 23%, while China accounted for 16%, Germany for 7%, Canada for 6%, and India for 5%.

United States

Domestic salt production in the United States was estimated to be 43.3 Mt in 1995, up from 39.8 Mt in 1994; the total value was estimated to be in excess of US$960 million. Twenty-seven companies operated sixty-seven plants in fourteen states. Apparent consumption in 1994 was 48.4 Mt, up 11.5% from 43.4 Mt in 1993; the 1995 figure is estimated to be higher at 49.5 Mt. The distribution of salt sold or used by type, in 1995, was: brine sales, 46%; rock salt, 36%; evaporated salt, 9%; and solar salt, 9%. The chemical industry consumed about 39% of the total salt sold, while road and ice control usage accounted for 35%, food and agricultural sectors for 6%, general industrial for 6%, and others for 14%. The 1994 estimated average unit value of salt from brine increased 3% to US$5.40/t and the average unit value for rock salt shipments increased 10% to US$22.33/t.

U.S. salt imports in 1995 were estimated at 8 Mt, a 17% decrease over 1994. The major exporting countries were Canada (46%), followed by Mexico (25%) and the Bahamas (13%). The net import reliance of the United States for 1995 was estimated at 15% of apparent consumption, while salt exports increased by 11% to 0.8 Mt.

The main event in the U.S. salt industry in 1995 continued to be the flooding of the Retsof, New York, rock salt mine that began in mid-March 1994. The Retsof mine, which is the property of Akzo Salt Ltd., is the largest underground room-and-pillar mine in the Western Hemisphere with a production capacity of about 4 Mt/y, and it had been in operation since its opening in 1885. Despite several attempts to stop the flooding, the mine was filling at a daily rate of about 98 million litres. Surface effects were increasingly visible. By November 1994, Akzo decided to abandon the mine and look for a new site. The mine was permanently shut down on September 11, 1995, when all production stopped. During the last months of operation, the company stockpiled 2.3 Mt of rock salt for the 1995/96 winter. The company also plans to start a new mine of similar capacity (3.6 Mt/y) south of Retsof, at Hampton Corners in Groveland, New York. The lost capacity was quickly replaced by imports and by increased output from all other U.S. salt producers. The new mine is schedule to become operational in 1997.

A new refined salt operation in Tennessee, where salt will be recovered as a by-product from a titanium dioxide facility, will compensate for the closure of a vacuum pan salt facility at Manistee, Michigan.

A substantial user of salt, the U.S. chloralkali industry operated at near its full production capacity throughout 1995, with most of the output destined for the production of polyvinyl chloride and vinyl chloride monomer. In the United States, the demand for chlorine is expected to grow 1.5-2%/y, despite the environmental concerns regarding this chemical.

INTERNATIONAL 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. As a consequence, international trade in salt is small relative to world production, i.e., about 20% of total world production. Trade in the Pacific area currently accounts for one half of seaborne movements, followed by North America (24%) and northwestern Europe (20%). Australia is expected to remain the major supplier to Japan, while Mexico will continue to export mainly to Japan and North America. Exports to the European Union are expected to remain minimal as this region is essentially self-sufficient. However, to the Canadian salt industry, only facts relevant to the United States are of interest.

PRICES

The price of salt depends on factors such as production methods, purity, scale of operations, transportation costs, and product availability. During those periods when a shortage occurs because of strikes or technical problems, prices for salt will likely rise until alternative sources are found. In peak periods of demand, de-icing rock salt prices may increase if harsh winter conditions persist. Most likely, the replenishment of stocks during such periods will be at higher prices.

The price of salt products for 1995 rose by an average of about 3% when compared to 1994 prices. Rock-salt de-icing grades in bulk delivery sold for $17-$34/t f.o.b. mine and $31-$66/t f.o.b. depot, or $4-$8 per 40-kg bag. Fine-evaporated salt sold for $86-$128/t, or $6-$11 per 40-kg bag. Water-conditioning grades varied between $5 and $10 per 40-kg bag, while domestic salt varied between $16 and $18 per 25-kg bale. Agricultural grades were $3-$10 per 20-kg lick block, and $4-$11 per 25-kg paper bag.

The price difference for salt between eastern Canada and the prairie provinces was highest for agricultural products; 20-kg lick blocks were 19-44% higher, and 25-kg stock paper bags were 24-46% higher in the eastern provinces. Ontario has the lowest prices for water-conditioning and domestic salt, while the prairie provinces are enjoying the lowest prices for agricultural salt. Prices on the west coast were comparable to prices in the eastern provinces.

OUTLOOK

In 1996, domestic production and consumption of salt is forecast to remain stable. Imports of salt are likely to increase slightly from 1995 levels, in part to compensate for some of the lost production associated with the temporary closure of the Magdalen Islands mine. Rock salt prices are expected to increase by

about 3%, and the price of value-added products should perform differently according to the product.

Despite environmental pressures and the recent inclusion on PSL2, de-icing salt will continue to be the major de-icing agent because of its low price. The optimization of spreading rates, in combination with the search for adequate abrasive mixtures, will continue to be evaluated. The winter of 1995/96, although considered a harsh winter in the north-eastern United States, can only be considered a normal winter for Canada and therefore should not result in above-average demand for de-icing salt.

The pulp and paper industry, the major consumer of chloralkali, is expected to have a similar year to 1995 and, as a consequence, operating rates should remain at around 95%. Demand in the chloralkali sector is forecast to grow at a marginal rate of 1-2%, while consumption is expected to continue to decline in the pulp and paper sector. (It is believed that less than 15% of the chlorine consumed in North America is used to bleach pulp.) This decline will be offset by an anticipated continued growth in the polyvinyl chloride (PVC) sector in which sales of chlorine will register an annual increase of 4-5%. PVC output should continue to grow in 1996, mainly because of strength in the export market. Conversely, Canadian demand for PVC in 1996 is expected, at best, to remain similar to 1995 as no improvement in the housing sector is expected.

In North America, the consumption of sodium chlorate is forecast to continue to grow at a rate of 11-13%/y. In Canada, the sodium chlorate industry experienced strong growth of about 11% in 1995 and is expected to enjoy similar growth in 1996. No new facility is currently planned for 1996; however, a 30% increase is planned by CXY Chemicals Canada Ltd. Partnership at its Bruderheim plant.

Sales of salt in the fisheries and food industries are believed to have now reached a plateau, but for different reasons. The Canadian fisheries seem to have completed their round of cuts in fish quotas. In the food industry, the concerns over salt in diets seem to be less important to the consumers (many products presented are already low in sodium content) and no further reduction is expected. Salt substitutes are still making some gains in this market.

A new but restricted market is currently being investigated by the industry. This market results from a Japanese fashion to use salt in many cosmetic and body-care products. The ageing but wealthy population of baby-boomers could be a good target for this new industry.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 70. (2) Information in this review was current as of December 31, 1995.

TARIFFS

Item No.	Description	Canada			United States
		MFN	GPT	USA	Canada
2501.00	Salt (including table salt and denatured salt) and pure sodium chloride, whether or not in aqueous solution; seawater				
2501.00.10	Table salt made by an admixture of other ingredients when containing 90% or more of pure sodium chloride	3.5%	1%	Free	Free
2501.00.90	Other	Free	Free	Free	Free

Sources: Customs Tariff, effective January 1996, Revenue Canada; Harmonized Tariff Schedule of the United States, 1996.

TABLE 1. CANADA, SALT SHIPMENTS AND TRADE, 1994 AND 1995

Item No.		1994		1995p	
		(tonnes)	($000)	(tonnes)	($000)
SHIPMENTS					
	By type				
	Mined rock salt	9 446 002	209 698	7 933 863	174 780
	Fine vacuum salt	822 181	85 222	835 308	86 848
	Salt content of brines used or shipped	1 975 704	5 804	2 002 934	6 266
	Total	12 243 887	300 723	10 772 105	267 895
	By province				
	Nova Scotia	x	x	x	x
	New Brunswick	x	x	x	x
	Quebec	x	x	x	x
	Ontario	7 227 150	174 363	6 702 471	161 694
	Saskatchewan	601 695	26 884	651 635	26 541
	Alberta	x	x	x	x
	Total	12 243 887	300 723	10 772 105	267 895
IMPORTS					
2501.00	Salt[1]				
	United States	602 793	26 013	847 287	31 426
	Mexico	313 351	4 208	335 776	4 893
	Chile	–	–	78 808	963
	Bahamas	14 742	324	13 791	275
	France	1 392	159	2 467	223
	Netherlands Antilles	1 548	139	828	66
	People's Republic of China	1 456	13	518	10
	Other countries	4 849	341	15 449	450
	Total	940 131	31 197	1 294 924	38 320
	By province of clearance				
	Newfoundland	7 959	233	7 973	214
	Prince Edward Island	–	–	24	3
	Nova Scotia	6 978	119	6 082	103
	New Brunswick	307	44	786	122
	Quebec	109 248	3 460	533 947	11 551
	Ontario	392 594	19 202	269 307	17 529
	Manitoba	14 279	438	7 470	458
	Saskatchewan	2 085	207	853	129
	Alberta	19 426	872	8 877	792
	British Columbia	387 255	6 617	459 605	7 416
	Total	940 131	31 197	1 294 924	38 320
EXPORTS					
2501.00	Salt[1]				
	United States	3 636 268	97 197	2 983 917	77 592
	St. Pierre and Miquelon	860	87	1 254	132
	Barbados	405	50	334	68
	Saudi Arabia	560	172	200	75
	Jamaica	141	51	68	22
	Other countries	440	96	1 049	238
	Total	3 638 674	97 662	2 986 822	78 135

Sources: Natural Resources Canada; Statistics Canada.
– Nil; 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, 1980-95

	Producers' Shipments					
	Mined Rock	Fine Vacuum	In Brine and Recovered in Chemical Operations	Total	Imports	Exports
			(tonnes)			
1980	4 507 416	781 428	2 134 010	7 422 854	1 151 203	1 637 601
1981	4 371 314	764 037	2 107 243	7 242 594	1 254 992	1 507 710
1982	5 223 073	773 086	1 944 172	7 940 331	1 526 879	1 721 893
1983	5 846 994	714 464	2 040 925	8 602 383	814 250	1 914 629
1984	7 030 664	754 675	2 450 060	10 235 399	1 053 217	2 530 038
1985	6 608 739	805 209	2 670 749	10 084 697	1 255 518	2 263 076
1986	6 867 287	815 044	2 649 515	10 331 846	1 328 298	2 502 518
1987	6 670 863	866 475	2 591 715	10 129 053	1 112 102	1 924 686
1988	7 126 762	783 368	2 777 050	10 687 180	1 202 219	3 030 124
1989	7 548 732	821 284	2 788 395	11 158 411	2 360 432	2 137 321
1990	7 704 499	778 428	2 708 458	11 191 385	2 095 321	1 897 816
1991	8 615 755	799 563	2 455 541	11 870 859	1 202 880	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	1 051 096	3 079 298
1994	9 446 002	822 181	1 975 704	12 243 887	940 131	3 638 674
1995**p**	7 933 863	835 308	2 002 934	10 772 105	1 174 942	2 481 808

Sources: Natural Resources Canada; Statistics Canada.
p Preliminary.

TABLE 3. WORLD SALT PRODUCTION, 1990-95

Countries	1990	1991	1992	1993	1994**r**	1995**e**
			(000 tonnes)			
United States	36 955	35 895	34 784	38 665	39 500	42 300
China**e**	20 005	25 495	25 000	29 530	29 700	30 000
C.I.S.**e**	14 515	13 995	11 000	11 071	8 789	9 200
Germany**1**	15 085	13 780	13 125	12 607	12 700	13 000
Canada	11 190	10 995	11 088	10 993	12 243	10 770
India	9 500	9 500	9 503	9 502	9 500	9 500
France	7 540	6 500	6 600	6 100	5 440	5 500
United Kingdom	5 700	5 195	6 600	6 200	5 700	5 600
Mexico	7 135	7 595	7 600	7 240	7 460	7 500
Australia	7 440	7 790	8 000	9 000	7 800	8 000
Poland	4 810	3 900	3 900	4 000	3 800	3 800
Italy	4 080	4 000	4 100	3 700	3 100	3 500
Other	39 605	45 480	43 488	41 392	34 268	36 330
Total	183 560	190 120	184 788	190 000	180 000	185 000

Sources: Natural Resources Canada; U.S. Bureau of Mines.
e Estimated; **r** Revised.
1 Includes data from the former East and West Germany.

TABLE 4. CANADIAN SALIENT STATISTICS ON SALT

Company	Location/ Initial Production	Employment 1993	Employment 1994	Annual Production Capacity 1991	1992	1993	1994	1995	Remarks
						(000 t/y)			
Albchem Industries Ltd.	Bruderheim, Alta./1991	10[a]	10	29	29	29	29	29	Brining to produce sodium chlorate.
CXY Chemicals Canada Ltd. Partnership	Bruderheim, Alta./1991	5[a]	5	26	26	28	28	28	Brining to produce sodium chlorate.
Canadian Salt Company Limited, The	Pugwash, N.S./1959	206[b]	206[b]	1 200	1 200	1 200	1 200	1 200	Rock salt mining to a depth of 305 m.
	Pugwash, N.S./1962			110	110	110	110	110	Dissolving rock salt fines for vacuum pan evaporation.
	Îles-de-la-Madeleine, Que./1982	184	183	1 500	1 500	1 500	1 500	1 300	Rock salt mining to a depth of up to 273 m. Closed temporarily in 1995. Expected to re-open in 1997.
	Ojibway, Ont./1955	245	245	2 500	2 500	2 500	2 500	2 500	Rock salt mining at a depth of 300 m.
	Windsor, Ont./1892	118	111	150	150	170	170	170	Brining, vacuum pan evaporation.
	Belle-Plaine, Sask./1969	28	28	170	170	170	170	170	Producing fine salt from by-product brine from nearby potash operation.
	Lindbergh, Alta./1968	61	60	140	140	140	140	140	Brining, vacuum pan evaporation.
Subtotal		842	833						
Central Canada Potash Ltd.	Colonsay, Sask./1992	9	9	–	100	300	328	328	By-product rock salt from potash operation.
Dow Chemical Canada Inc.	Fort Sask., Alta./1968	3[a]	3	1 400	1 400	1 400	1 400	1 400	Brining to produce caustic soda and chlorine.
General Chemical Canada Ltd.	Amherstburg, Ont./1919	6[a]	6	690	690	690	690	690	Brining to produce sodium carbonate.
International Minerals & Chemical Corporation (Canada) Limited	Esterhazy, Sask./1962	8	11	120	120	120	150	180	By-product rock salt from potash mine for use in snow and ice control.
Nusalt	Rocanville, Sask./1990	12	12	100	140	140	140	140	By-product rock salt from potash tailings.
Potash Corporation of Saskatchewan – New Brunswick Division	Sussex, N.B./1980	27	27	500	500	550	550	585	Rock salt produced in association with potash for use in snow and ice control.

Saskatoon Chemicals – a division of Weyerhaeuser Canada Ltd.	Saskatoon, Sask./1968	5[a]	5	70	70	75	75	82	Brining to produce caustic soda, chlorine and sodium chlorate.
Sifto Canada Inc.	Nappan, N.S./1947	82	64	100	100	100	100	100	Brining for vacuum pan evaporation.
	Goderich, Ont./1959	319	350	3 300	3 300	3 300	3 700	3 700	Rock salt mining at a depth of 536 m.
	Goderich, Ont./1880	66	68	120	120	120	120	120	Brining for vacuum pan evaporation.
	Unity, Sask./1949	73	70	180	180	180	180	180	Brining vacuum pan evaporation.
Subtotal		540	552						Fusion plant closed in 1991.
Total		1 467	1 473	13 405	13 545	13 272	13 280	13 152	

Sources: Natural Resources Canada; company surveys.
– Nil.
[a] Employment part of chemical complex. [b] Includes employment in brining operations at Pugwash.

TABLE 5. CANADIAN CHEMICAL PLANTS USING SALT AS A MAJOR RAW MATERIAL, DEVELOPMENTS AND PROJECTS IN 1995

Company	Location	Parent Company	Plant Location	Type of Cells	Products	Annual Capacity[r] (tonnes)	Remarks
Akzo Nobel Canada Inc.	Magog, Quebec	Akzo Nobel Industries SV, Netherlands	Magog, Quebec	Metal	Sodium chlorate	122 000	
	Valleyfield, Quebec		Valleyfield, Quebec	Metal	Sodium chlorate	113 000	
Albchem Industries Ltd.	Bruderheim, Alberta	Sherritt Gordon Limited, Vencap Equities Alberta Ltd., Alberta	Bruderheim, Alberta	Metal	Sodium chlorate	55 000	Captive production.
B.C. Chemicals Ltd.	Prince George, British Columbia	B.C. Chemicals Ltd., Prince George, B.C.	Prince George, British Columbia	Metal	Sodium chlorate	67 000	
CXY Chemicals Canada Ltd. Partnership	Calgary, Alberta	Occidental Petroleum Corporation, Los Angeles, CA, U.S.A.	Amherstburg, Ontario	Metal	Sodium chlorate	50 000	
			Brandon, Manitoba	Metal	Sodium chlorate	85 000	
			Bruderheim, Alberta	Metal	Sodium chlorate	50 000	Captive production. Plan to increase production to 65 000 t/y by mid-1996.
			North Vancouver, British Columbia	Diaphragm	Caustic soda Chlorine	155 000 141 000	
Domtar Inc.			Lebel-sur-Quévillon, Quebec		Sodium chlorate	20 000	
Dow Chemical Canada Inc.	Sarnia, Ontario	The Dow Chemical Company, Michigan, U.S.A.	Fort Saskatchewan, Alberta	Diaphragm	Caustic soda Chlorine	524 000 476 000	
General Chemical Canada Ltd.	Amherstburg, Ontario	General Chemical Corporation, Morristown, New Jersey, U.S.A.	Amherstburg, Ontario	Metal	Calcium chloride Sodium carbonate	450 000 400 000	
Great Lakes Forest Products Limited	Thunder Bay, Ontario	Canadian Pacific Securities Limited, Montréal, Quebec	Dryden, Ontario	Membrane	Caustic soda Chlorine	24 000 22 000	
ICI Canada Inc.	Montréal, Quebec	Imperial Chemical Industries plc (ICI), England	Bécancour, Quebec	Diaphragm	Caustic soda Chlorine	325 000 295 000	Capacity to be increased by 20 000-25 000 t/y.
.			Cornwall, Ontario	Mercury	Caustic soda Chlorine	38 500 35 000	Closed in 1995.
			Dalhousie, New Brunswick	Metal	Sodium chlorate	22 000	
				Mercury	Caustic soda Chlorine	31 000 28 000	

PPG Canada Inc., Industrial Chemical Division	Beauharnois, Quebec	PPG Industries, Inc., Pittsburgh, Penn., U.S.A.	Beauharnois, Quebec	Metal	Sodium chlorate	40 000	
				Membrane	Caustic soda	80 000	
					Chlorine	73 000	
St. Anne Chemicals Company Ltd.	Nackawic, New Brunswick	Parsons & Whittemore, Inc., New York, U.S.A.	Nackawic, New Brunswick	Metal	Sodium chlorate	12 500	Captive production.
				Membrane	Caustic soda	10 000	Captive production.
					Chlorine	9 000	
Saskatoon Chemicals	Saskatoon, Saskatchewan	Weyerhaeuser Canada Ltd., Kamloops, B.C.	Saskatoon, Saskatchewan	Metal	Sodium chlorate	44 000	
				Membrane	Caustic soda	36 000	
					Chlorine	33 000	
Sterling Pulp Chemicals	Islington, Ontario	Sterling Chemical Inc., Texas, U.S.A.	Buckingham, Quebec	Metal	Sodium chlorate	132 000	
			Grande Prairie, Alberta	Metal	Sodium chlorate	45 000	
			Thunder Bay, Ontario	Metal	Sodium chlorate	53 000	
			North Vancouver, British Columbia	Metal	Sodium chlorate	92 000	

Sources: Natural Resources Canada; Chemicals Directorate and Investments, Industry, Science and Technology Canada.
. . Not available; r Revised.