

Lime

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INTRODUCTION

Lime, in the form of quicklime or hydrated lime, consists of CaO and MgO in various proportions. High-calcium quicklime contains 0-5% MgO and is the most common type of lime produced. Magnesium quicklime contains 5-35% MgO, and dolomitic quicklime (also referred to as dolime) contains 35-45% MgO. Hydrated lime (calcium hydroxide, Ca(OH)₂), also known as slaked lime, is a dry powder manufactured by adding water to quicklime, converting the oxide to hydroxide. To produce lime, crushed limestone is burned in a kiln at temperatures ranging from 890° to 1340°C. A dissociation reaction takes place when the limestone is broken down, releasing CO₂ and producing CaO or CaO.MgO (quicklime).

CANADIAN INDUSTRY

In Canada, lime companies operated 14 plants in six provinces (New Brunswick, Quebec, Ontario, Manitoba, Alberta and British Columbia) as of December 31, 2003 (Figure 1). In 2003, Canadian lime producers shipped 2.214 Mt of quicklime and hydrated lime, valued at \$228.3 million, based on preliminary data. Total 2003 production is estimated at 2.226 Mt. When compared to 2002 final data, this represents a reduction of 1.4% in the amount of lime shipped (Tables 1 and 2). Canada ranks an estimated ninth among lime-producing countries due to its relatively large chemical and industrial requirements. Quicklime accounted for 91.7% of the total volume and 90.2% of the value of shipments. Production figures do not include some captive production from pulp and paper plants. In terms of capacity utilization, Canadian production represents about 72% of published capacity, combining both merchant and captive production. In terms of production trends, Figure 2 shows quicklime and hydrated

lime production for the period 1992-2003. The trend is flat (190 000-250 000 t) for hydrated lime and virtually unchanged for quicklime with a production peak at around 2.3 Mt in 1999.

Total calcining capacity for active plants increased 10% to 3 401 000 t/y, as shown in Table 3. The Summit, Alberta plant of Graymont Western Canada Inc. was not in production in 2003. Eleven of the fourteen plants produce quicklime and hydrated lime for the merchant market. The three remaining plants produce lime for captive industrial processes (steel, sugar refining, specialty metals). The industry employed about 700 people in 2003.

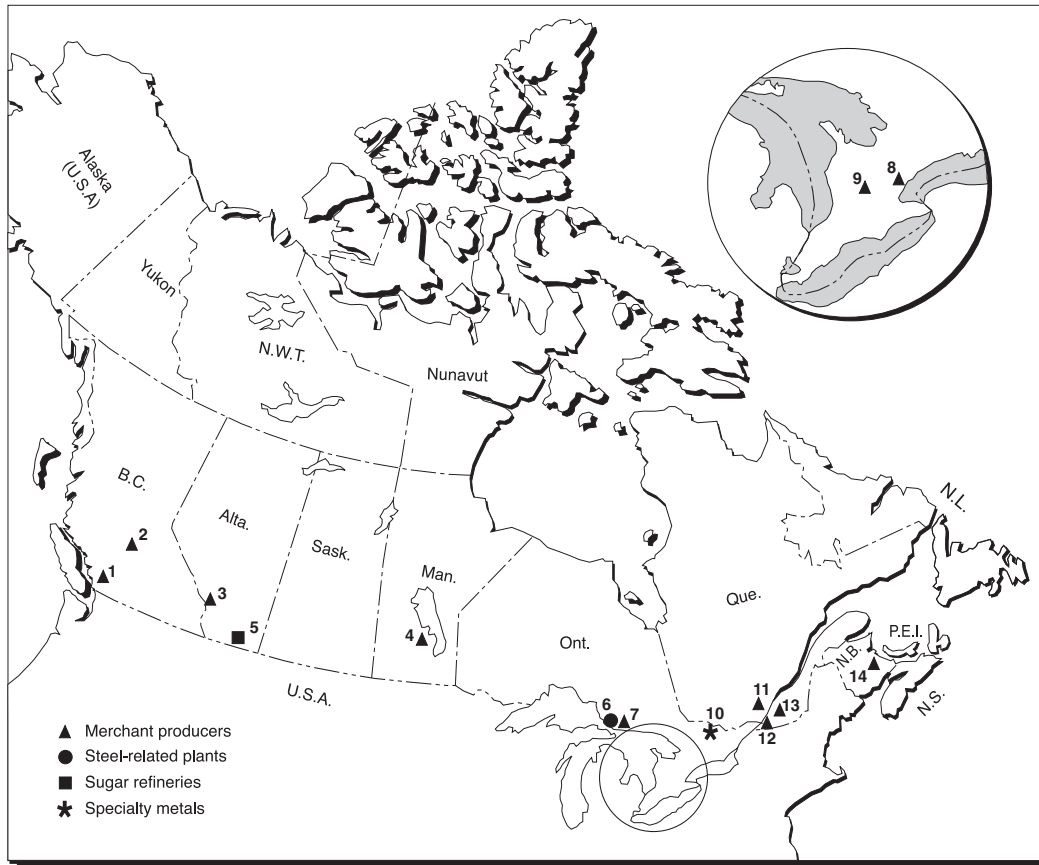
The Graymont group of companies operates seven plants across Canada as well as plants and quarries in Ohio, Pennsylvania and northern New York. The parent company, Graymont Inc., is based in Bellingham, Washington. Carmeuse North America Group, based in Pittsburgh, Pennsylvania, has complete or partial ownership of three lime plants in Ontario and is the leading producer of lime in North America. It also has lime plants in Pennsylvania, Ohio, Michigan, Indiana, Illinois and Kentucky. Chemical Lime Company of Canada Inc., part of Belgium-based Lhoist Group, with one operation in British Columbia, is the second largest lime producer in North America.

USE

Lime has a variety of industrial uses. A major use for lime is in the manufacture of steel, where it is used in electric arc and basic oxygen furnaces as a flux to remove impurities such as phosphorus, sulphur and silica. With the trend to the electric arc process over the basic oxygen process, the requirements for process lime are lower. In basic oxygen steel-making, 1 t of steel ingot requires about 75 kg of lime as a fluxing agent. In electric arc furnaces, the lime requirement is about half that of the basic oxygen furnace.

Dolomitic quicklime is also used in the steel manufacturing process as it extends refractory brick life. Pulp and paper manufacturing uses lime to recapture caustic soda in the sulphate (kraft) paper process. Most paper plants recover the lime for re-use by dewatering the calcium carbonate mud. Thus, the commercial market for quicklime in the paper sector is limited to "make-up" lime. In

Figure 1
Lime Producers in Canada, 2003



MERCHANT PRODUCERS

- 1. Chemical Lime Company of Canada Inc., Fort Langley
- 2. Graymont Western Canada Inc., Pavilion Lake
- 3. Graymont Western Canada Inc., Exshaw
- 4. Graymont Western Canada Inc., Faulkner
- 7. Carmeuse North America Group, Spragge
- 8. Lafarge Lime (Canada) Inc., Dundas Division
- 9. Carmeuse North America Group, Ingersoll
- 11. Graymont (QC) Inc., Joliette
- 12. Graymont (QC) Inc., Bedford
- 13. Graymont (QC) Inc., Marleton
- 14. Graymont (NB) Inc., Havelock

STEEL-RELATED PRODUCERS

- 6. Algoma Steel Inc., Sault Ste. Marie

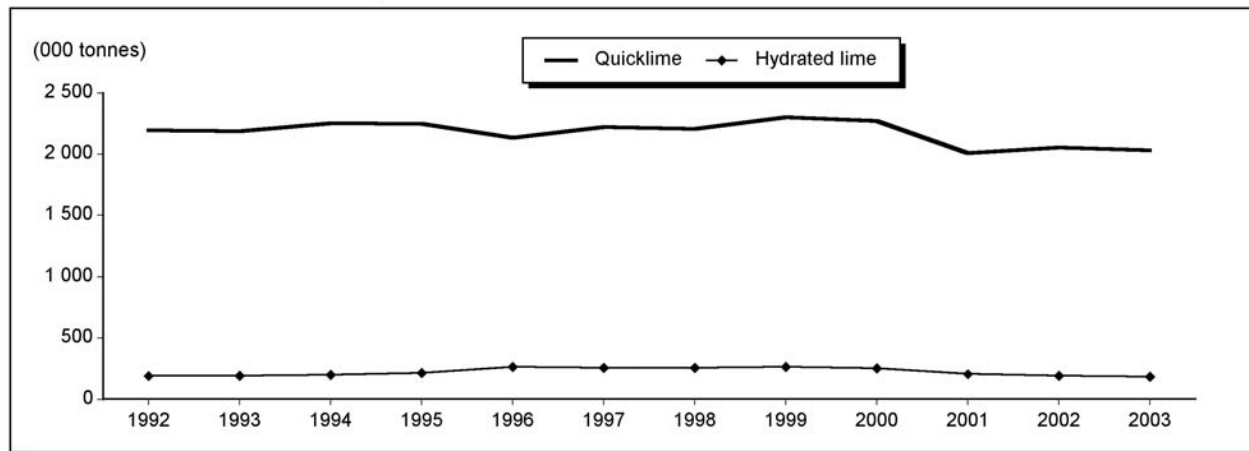
SUGAR REFINERIES

- 5. Rogers Sugar Ltd., Taber

SPECIALTY METALS

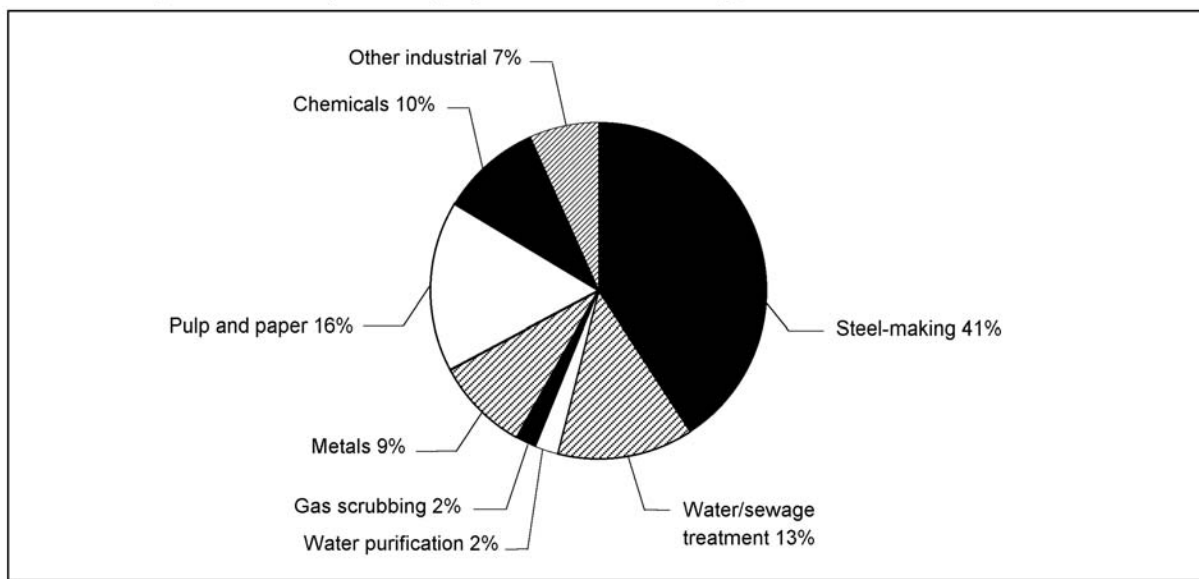
- 10. Timminco Limited, Haley Station

Figure 2
Canadian Lime Production, 1992-2003



Source: Natural Resources Canada.

Figure 3
Lime Use (Quick and Hydrated), by Canadian Industry, 2003



Source: Natural Resources Canada.

wastewater treatment plants, lime creates a high pH environment that acts to precipitate toxic heavy metals and destroy harmful pathogens in wastewater and organic sludges. Lime is also used in the manufacture of refined sugar and precipitated calcium carbonate. Another use for lime that will continue to grow is for the removal of sulphur dioxide from flue gases at coal-fired thermal electricity plants. The MEL (magnesium-enhanced lime) process is a wet lime process that absorbs SO_2 and produces

by-product calcium sulphite. Lime can also be used as a soil stabilizer in construction projects and as an additive to asphalt where it acts as an anti-stripping agent and also reduces the rutting of pavement. Lime is used in metal concentration processes where it acts as a flotation agent in the recovery of nonferrous ores (copper, zinc, etc.) and to maintain proper alkalinity in the flotation circuit. In gold recovery, lime is used to prevent the loss of cyanide and to maintain optimum pH.

High-calcium quicklime is commercially available in a variety of forms, including lump, crushed, pebble, ground and pulverized. Slaked lime, produced by mixing quicklime with water, can be purchased as a putty, dry powder or slurry. Aglime, or agricultural lime, is pulverized limestone that is used for soil neutralization.

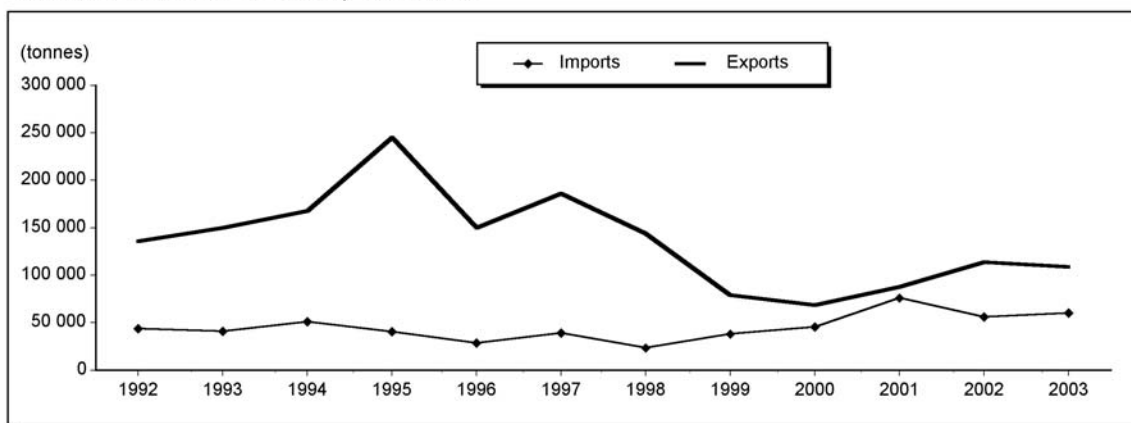
Lime consumed in Canada is used in the manufacture of numerous products and for various chemical processes, and this comprises the merchant market. The use of quicklime, based on reported shipments for the merchant market, amounted to an estimated 1 502 409 t in 2003, compared to 1 522 451 t (revised) in 2002. The major end uses for quicklime in 2003 were steel-making (44.2%), environmental control (12%), pulp and paper (17.6%),

chemicals (10.3%), metal concentration (10.1%), and other industrial uses (5.6%). Hydrated lime shipments in the merchant market amounted to an estimated 148 605 t in 2003, compared to 165 694 t (revised) in 2002. The major uses for this lime in 2003 were environmental control (65%), other industrial uses (15.8%), and road construction and soil stabilization (13.8%). A summary of lime use (both quicklime and hydrated lime) is shown in Figure 3.

TRADE

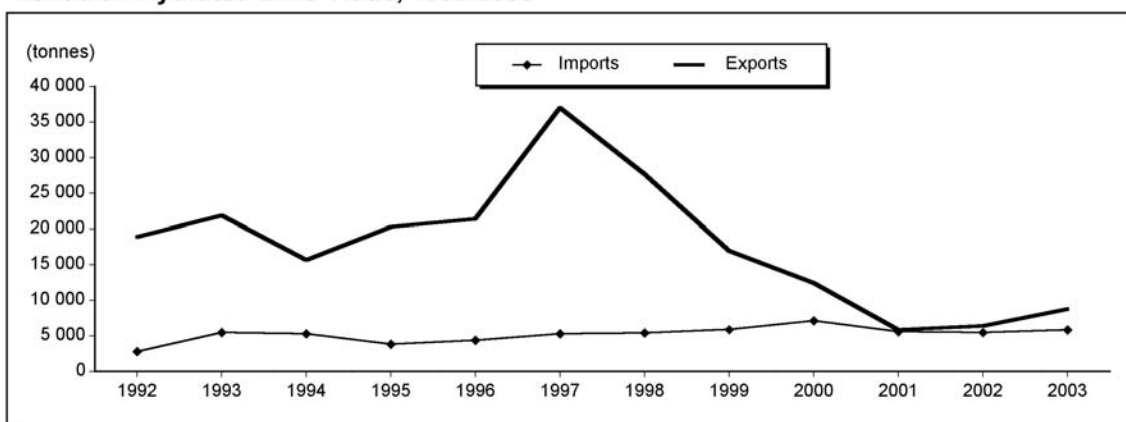
The proximity of lime plants to U.S. markets continued to make the United States the export market of choice for

Figure 4
Canadian Quicklime Trade, 1992-2003



Source: Natural Resources Canada.

Figure 5
Canadian Hydrated Lime Trade, 1992-2003



Source: Natural Resources Canada.

Canadian quicklime producers with 2003 exports estimated at 108 562 t and imports at 60 165 t (Table 1). This represents a 4.3% decrease in exports of quicklime, compared to 2002 data. Hydrated (slaked) lime imports in 2003 were estimated at 5809 t versus exports of 8764 t. Canada imported more calcined dolomite from the United States than it exported (48 774 t and 9913 t, respectively). Figure 4 shows quicklime trade for the period 1992-2003. It shows that during the period 2000-2002, there was an increase in exports of quicklime over imports. However, exports in 2003 are down marginally from 2002. Figure 5 shows hydrated lime trade data for the same period. A general trend for the period shown indicates an overall decrease in exports and a slight increase in imports. Imports and exports of quicklime and hydrated lime with the United States vary from year to year depending upon local market demands in the industrial sectors that consume lime.

INTERNATIONAL OVERVIEW

World lime production, based on figures from the U.S. Geological Survey (USGS), is estimated at 117 Mt in 2003, compared to 116 Mt in 2002 (Table 5, Figure 6). Production was led by China (23.5 Mt) followed by the United States (18.2 Mt). Other leading countries included Russia, Japan and Germany with 8.0 Mt, 7.4 Mt and 6.8 Mt, respectively.

The United States produced 17.9 Mt of lime in 2002, based on final USGS figures, compared to 18.9 Mt in 2001

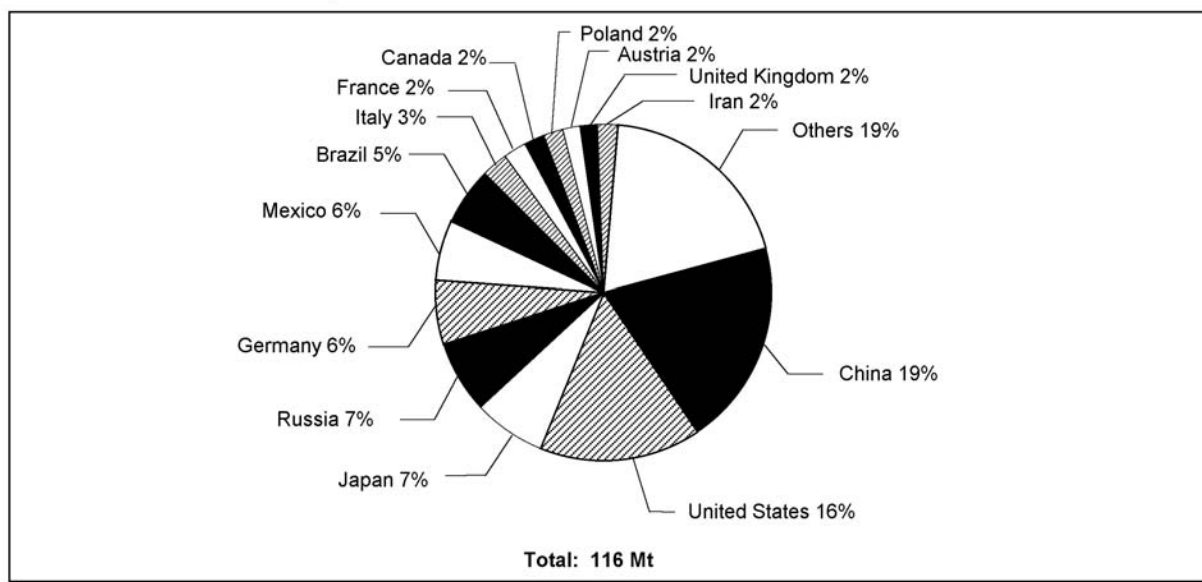
and 19.6 Mt in 2000. The largest lime producers in the United States are Carmeuse North America Group, Chemical Lime Company and Graymont Inc.

Carmeuse North America Group consolidated its Michigan operations by idling the Detroit, Michigan, plant and moving operations to the River Rouge plant, also in Michigan. Lime production in the northeastern United States is strategic in relation to the overall trade balance with Canada, and changes in the operational status of plants in these areas are important for Canadian producers. This factor results from the fact that the majority of lime production in the region comes from plants owned by Carmeuse North America or Graymont Inc., and production can easily be switched from sister plants in the United States or Canada, depending on market conditions. Two lime plants in Illinois, owned by Vulcan Materials Co., were closed due to environmental compliance issues. The plants, which produced high-calcium quicklime and dolomitic quicklime, had a combined capacity of 345 000 t/y (USGS).

PRICES

Prices for lime produced in Canada vary according to region, company marketing strategies, and supply and demand forces in effect. The average reported values (f.o.b. plant), based on producers' shipments as listed in Table 1, were \$101.52/t for quicklime and \$120.68/t for hydrated lime in 2003, representing an increase of 5% for quicklime and no change for hydrated lime.

Figure 6
World Lime Production, 2002



Source: U.S. Geological Survey.

INDUSTRY NEWS

Birch Mountain Resources Ltd. of Calgary, Alberta, has announced plans to develop the Muskeg Valley quarry, located about 65 km north of Fort McMurray, Alberta. The site contains a substantial resource of limestone deposit that would be mined to supply construction aggregates and quicklime for flue-gas desulphurization processes in the Alberta oilsands. A preliminary assessment has shown the potential to supply 350 000 Mt/y of quicklime and 6.9 Mt/y of construction and concrete aggregates. Current quicklime requirements for the oilsands area are supplied by plants in southern Alberta, about 600 km away.

Gossan Resources Limited of Winnipeg, Manitoba, is conducting a preliminary feasibility study on its Inwood magnesium project located 80 km north of Winnipeg. The property consists of a high-purity dolomite deposit from which high-magnesium dolomitic lime would be produced. A resource of 67 Mt of high-purity magnesium dolomite (21.6% MgO) has been outlined on the property.

ENERGY AND TECHNOLOGY

Most lime plants in Canada consist of long rotary or vertical-shaft kilns with preheaters and computerized process control systems. Kilns in Canada use natural gas, coke and petroleum coke as fuels, and energy costs comprise about 40% of total production costs. Vertical-shaft kilns are more energy-efficient than rotary kilns but produce a lower-quality product that is not suitable for some industrial applications due to its high sulphur content. Table 3 shows the types of kilns used at Canadian merchant lime plants. Energy consumption per tonne of lime produced averages 6.0 gigajoules (GJ) for kilns in use in Canada.

About 60% of CO₂ emissions from lime kilns is related to the calcination process, but this figure varies somewhat depending upon the chemical composition of the limestone used. Reductions in CO₂ emissions will be achieved through advancements in kiln efficiencies that reduce the fuel requirements per tonne of lime produced and the implementation of CO₂ sequestration processes.

The U.S. Environmental Protection Agency has issued new guidelines aimed at reducing particulate matter (PM) emissions from U.S. lime plants. New U.S. limits of 0.60 lb/short ton of kiln feed apply to existing kilns with wet scrubbers, while the PM limit at a new lime plant has been set at 0.10 lb/short ton of feed.

OUTLOOK

The production of quicklime in Canada in 2004 is expected to increase slightly given the recent difficulties being experienced in the steel sector and lower demand in

the transportation sector. On January 29, 2004, Stelco Inc., a major Canadian steel producer, received protection under the *Companies' Creditors Arrangement Act* to allow the company to proceed with a restructuring designed to keep it from bankruptcy. As steel-making is the biggest consumer of quicklime, any decrease in steel output in Canada will negatively affect quicklime shipments. According to the Canadian Steel Producers Association, shipments of Canadian steel products should show an increase in the 5-7% range for 2004.

Demand should continue to increase for lime for SO₂ abatement processes (flue gas desulphurization) at coal-fired generating plants, primarily in the United States, as utility companies continue to upgrade power units with scrubber systems to remove SO₂ from exhaust gases. Most companies in the United States are installing wet lime scrubber systems at existing power plants that use the MEL process. For example, Duke Power of Charlotte, North Carolina, has announced plans to retrofit 12 units at four power stations in North Carolina with wet lime scrubber systems by 2013. This US\$1.5 billion project will reduce nitrogen oxide emissions by 33% and sulphur dioxide emissions by 70%. The company is also evaluating the economics of producing a wallboard-grade gypsum by-product. Some of this increased demand for SO₂ abatement lime in the United States may translate into increased exports of quicklime from Canada to the northeastern United States.

Depending on the levels of new highway construction in the United States and Canada, demand for both quicklime and hydrated lime may increase in the coming years. The U.S. Congress has passed a resolution that could lead to a dramatic increase in highway construction for the period 2004-09. The trend in the United States is towards ultra-thick asphalt pavements that have a lifespan of up to 50 years. Lime is used for stabilization in the base and sub-base, as well as in the asphalt mix to increase moisture resistance and reduce rutting.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of June 2004. (3) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/com_e.html.

NOTE TO READERS

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TARIFFS

Item No.	Description	Canada			United States
		MFN	GPT	USA	Canada
2522.10	Quicklime	Free	Free	Free	Free
2522.20	Slaked lime	Free	Free	Free	Free
2522.30	Hydraulic lime	Free	Free	Free	Free

Sources: Canadian *Customs Tariff*, effective January 2004, Canada Border Services Agency; Harmonized Tariff Schedule of the United States, 2004.

TABLE 1. CANADA, LIME PRODUCTION AND TRADE, 2001-03

Item No.	2001		2002		2003	
	(tonnes)	(\$000)	(tonnes)	(\$000)	(tonnes)	(\$000)
PRODUCTION (1)						
By type						
Quicklime	2 007 078	189 672	2 054 443	197 507	2 031 365	206 232
Hydrated lime	205 568	24 159	193 089	23 025	183 600	22 156
Total	2 212 646	213 831	2 247 532	220 532	2 214 965	228 388
By province						
New Brunswick	x	x	x	x	x	x
Quebec	x	x	x	x	x	x
Ontario	1 066 204	96 746	1 121 822	103 205	1 020 400	103 768
Manitoba	x	x	x	x	x	x
Alberta	x	x	x	x	x	x
British Columbia	x	x	x	x	x	x
Total	2 212 646	213 830	2 247 532	220 532	2 214 965	228 388
IMPORTS (2)						
2518.20	Calcined dolomite					
	United States	19 436	2 683	46 590	6 938	48 774
	Italy	-	-	25	18	-
Total	19 436	2 683	46 615	6 956	48 774	6 462
2522.10	Quicklime					
	United States	75 610	8 475	55 529	6 753	59 916
	United Kingdom	219	28	100	18	159
	Switzerland	27	3	18	3	87
	Canada	11	2	6	1	3
	India	71	11	406	70	-
Total	75 938	8 519	56 059	6 845	60 165	6 314
2522.20	Slaked lime					
	United States	5 548	1 281	5 459	1 281	5 805
	Germany	-	-	5	2	4
	United Kingdom	2	1	-	-	-
	France	-	-	1	-	-
Total	5 550	1 282	5 465	1 283	5 809	1 232
2522.30	Hydraulic lime					
	United States	12 661	2 000	8 505	1 479	10 550
	France	-	-	289	95	1 748
	United Kingdom	-	-	1	-	5
	Germany	2	1	5	2	-
Total	12 663	2 001	8 800	1 576	12 303	2 365
Total imports	113 587	14 485	116 939	16 660	127 051	16 373
EXPORTS						
2518.20	Calcined dolomite					
	United States	11 134	4 648	9 785	1 214	9 913
2522.10	Quicklime					
	United States	87 588	14 297	113 458	22 395	108 562
2522.20	Slaked lime					
	United States	5 836	966	6 374	969	8 764
	France	2	1	2	1	-
Total	5 838	967	6 376	970	8 764	1 235
2522.30	Hydraulic lime					
	China	31	14	66	31	73
	Jamaica	-	-	-	-	16
	Trinidad and Tobago	-	-	-	-	21
	United States	59	42	162	61	70
Total	90	56	228	92	180	80
Total exports	104 650	19 968	129 847	24 671	127 419	22 222

Sources: Natural Resources Canada; Statistics Canada.

- Nil; x Confidential.

(1) Producers' shipments and quantities used by producers. (2) Includes re-imports. HS code 2522.30, as interpreted, applies mainly to hydrated lime.

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

TABLE 2. CANADA, LIME PRODUCTION, TRADE AND APPARENT USE, 1980 AND 1985-2003

	Production (1)			Imports	Exports	Apparent Use (2)
	Quick	Hydrated	Total			
	(tonnes)					
1980	2 364 000	190 000	2 554 000	40 901	403 166	2 191 735
1985	2 054 294	157 286	2 211 580	23 056	194 097	2 040 539
1986	2 069 043	173 534	2 242 577	46 917	189 512	2 099 982
1987	2 140 793	189 278	2 330 071	44 290	163 767	2 210 594
1988 (a)	2 306 831	211 151	2 517 982	32 543	122 900	2 427 625
1989	2 349 312	202 622	2 551 934	39 095	83 608	2 507 421
1990	2 137 996	202 741	2 340 737	43 715	138 409	2 246 043
1991	2 184 836	190 424	2 375 260	45 012	134 405	2 285 867
1992	2 193 752	190 592	2 384 344	55 706	173 248	2 266 802
1993	2 186 749	192 247	2 378 996	52 690	190 068	2 241 618
1994	2 250 205	198 818	2 449 023	66 886	193 902	2 322 007
1995	2 244 800	216 916	2 461 716	52 884	266 475	2 248 125
1996	2 134 437	267 595	2 402 032	36 639	216 849	2 221 822
1997	2 219 385	257 186	2 476 571	47 382	224 232	2 299 721
1998	2 204 957	256 086	2 461 043	(r) 34 031	171 446	(r) 2 323 628
1999	2 299 705	265 746	2 565 451	54 535	96 058	2 523 928
2000	2 271 277	254 092	2 525 369	62 296	80 631	2 507 034
2001	2 007 078	205 568	2 212 646	94 151	93 516	2 213 281
2002	2 054 443	193 089	2 247 532	70 324	120 062	2 197 794
2003 (p)	2 031 365	183 600	2 214 965	78 277	117 505	2 175 737

Sources: Natural Resources Canada; Statistics Canada.

(p) Preliminary; (r) Revised.

(a) Beginning in 1988, exports and imports are based on the new Harmonized System and may not be in complete accordance with previous method of reporting. Imports and exports include HS classes 2522.10, 2522.20 and 2522.30.

(1) Producers' shipments and quantities used by producers. (2) Production plus imports, less exports.

TABLE 3. CANADIAN LIME INDUSTRY, 2003

Company	Plant Location	Calcining Capacity	Ki/n Type	Market	Type of Quicklime and Other Products
(000 t/y)					
NEW BRUNSWICK					
Graymont (NB) Inc.	Havelock	175	V	Merchant	High-calcium (1)
QUEBEC					
Graymont (QC) Inc.	Marbleton	330	V, R	Merchant	High-calcium (1)
Graymont (QC) Inc.	Joliette	220	R	Merchant/captive	High-calcium (1)
Graymont (QC) Inc.	Bedford	400	R	Merchant	High-calcium
ONTARIO					
Algoma Steel Inc.	Sault Ste. Marie	200		Captive	High-calcium and dolomitic
Beachville Lime Limited	Ingersoll	720	R	Merchant	High-calcium (1) and dolomitic
Northern Lime Limited	Spragge	200	R	Merchant	High-calcium and dolomitic
Lafarge Lime (Canada) Inc., Dundas Division	Dundas	370	R	Merchant	High-calcium and dolomitic
Timminco Limited	Haley Station	53		Captive	Dolomitic
MANITOBA					
Graymont Western Canada Inc.	Faulkner	117	R	Merchant	High-calcium and dolomitic
ALBERTA					
Rogers Sugar Ltd.	Taber	66	..	Captive	High-calcium
Graymont Western Canada Inc.	Exshaw	180	R	Merchant	High-calcium (1)
BRITISH COLUMBIA					
Graymont Western Canada Inc.	Pavilion Lake	235	R	Merchant	High-calcium
Chemical Lime Company of Canada Inc.	Fort Langley	135	C	Merchant	High-calcium (1)

Source: Natural Resources Canada.

.. Not available.

Kiln type: V = vertical; R = rotary; C = calcimatic.

(1) Production of hydrated lime.

Note: Lantic Sugar Limited operates sugar refineries in Quebec and New Brunswick.

TABLE 4. CANADA, USE (1) OF DOMESTIC LIME, QUICK AND HYDRATED, 1997-2003

End Uses	1997	1998	1999	2000	2001	2002	2003
	(tonnes)						
CHEMICAL AND INDUSTRIAL							
Steel-making	807 000	707 482	780 877	632 284	530 605	730 180	664 225
Water and sewage treatment	278 986	310 510	296 053	224 074	197 817	233 036	213 391
Water purification	52 026	48 366	51 323	37 445	48 420	38 590	34 320
Gas scrubbing	9 376	15 060	16 309	7 629	6 742	22 803	30 229
Metal concentration	151 258	158 482	138 431	153 469	176 213	141 434	152 563
Pulp and paper mills	225 363	200 824	213 627	218 878	253 287	240 646	267 072
Chemicals	126 375	193 693	194 362	161 408	163 070	167 952	156 005
Other industrial uses	73 879	96 416	101 102	109 645	44 765	88 500	108 344
CONSTRUCTION							
Road and soil stabilization	12 458	14 323	15 810	x	x	x	x
Mason and finishing lime	x	x	x	x	x	x	x
Other	13 851	17 807	22 126	11 259	x	3 754	7 351
AGRICULTURE							
	x	x	x	4 699	x	x	x
Total use	1 762 334	1 765 697	1 834 124	1 571 293	1 447 722	1 688 145	1 651 014

Source: Natural Resources Canada.

x Confidential.

(1) Includes merchant market only; excludes companies that are completely captive producers/users.

TABLE 5. WORLD PRODUCTION OF QUICKLIME AND HYDRATED LIME, INCLUDING DEAD-BURNED DOLOMITE SOLD AND USED, 1998-2003

	1998	1999	2000	2001	2002	2003 (p)
	(000 tonnes)					
Canada	2 460	2 570	2 500	2 210	2 248	2 215
Brazil	5 700	5 700	5 700	6 300	6 300	6 500
China	21 000	21 500	21 500	22 000	22 500	23 500
France	2 800	2 400	2 400	2 400	2 500	2 500
Germany	7 600	7 600	7 600	7 000	7 000	6 800
Italy (1)	3 500	3 500	3 500	3 500	3 000	3 000
Japan (2)	8 100	7 750	7 700	8 100	8 050	7 400
Mexico	6 600	6 600	6 600	6 500	6 500	6 500
Poland	2 500	2 500	2 500	2 200	2 000	2 000
Russia	(3)	(3)	(3)	8 000	8 000	8 000
United Kingdom	2 500	2 500	2 500	2 500	2 000	2 000
United States	20 100	19 600	19 600	18 900	17 900	18 200
Other countries	33 050	33 650	33 995	28 056	28 002	28 385
Total	115 910	115 870	116 095	117 666	116 000	117 000

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

(p) Preliminary.

(1) Includes hydraulic lime. (2) Quicklime only. (3) Included with other countries.