

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°C to 1340°C. A dissociation reaction (calcination) takes place when the limestone is broken down, releasing CO₂ and producing CaO or CaO.MgO (quicklime).

CANADIAN INDUSTRY

In Canada, the lime industry is divided into merchant producers and captive producers. Merchant lime production is destined for a variety of users and industrial processes whereas captive production is a specific process requirement at one industrial plant. Lime for the merchant market is produced at eleven plants in six provinces (New Brunswick, Quebec, Ontario, Manitoba, Alberta and British Columbia). Captive production is confined to two plants in Ontario and one in Alberta. Figure 1 shows the location of all lime plants in Canada as of December 31, 2004.

In 2004, Canadian captive and merchant lime producers shipped 2.443 Mt of quicklime and hydrated lime valued at \$261.6 million based on preliminary data. Shipments in 2003 were 2.22 Mt. This represents a 10% increase in shipments. Table 1 provides statistics on Canadian production and trade while Table 2 shows apparent lime use in Canada for the period 1985-2004. Based on calcula-

tions in Table 2, lime use has increased 9% in the past year, reflecting strength in the steel industry and other sectors. Canada ranked tenth among major lime-producing countries in 2004, according to global production estimates by the U.S. Geological Survey. Quicklime accounted for 92.7% of the total volume and 91.4% of the value of shipments in 2004 (does not include some captive production from pulp and paper plants). The capacity utilization rate in 2004 was 71.2%, up from 65.4% for 2003 (based on merchant and captive production and published plant capacities). In terms of production trends, Figure 2 shows quicklime and hydrated lime production for the period 1992-2004.

Total calcining capacity for active plants stands at 3.401 Mt/y, as shown in Table 3. The industry employed about 700 people in 2004.

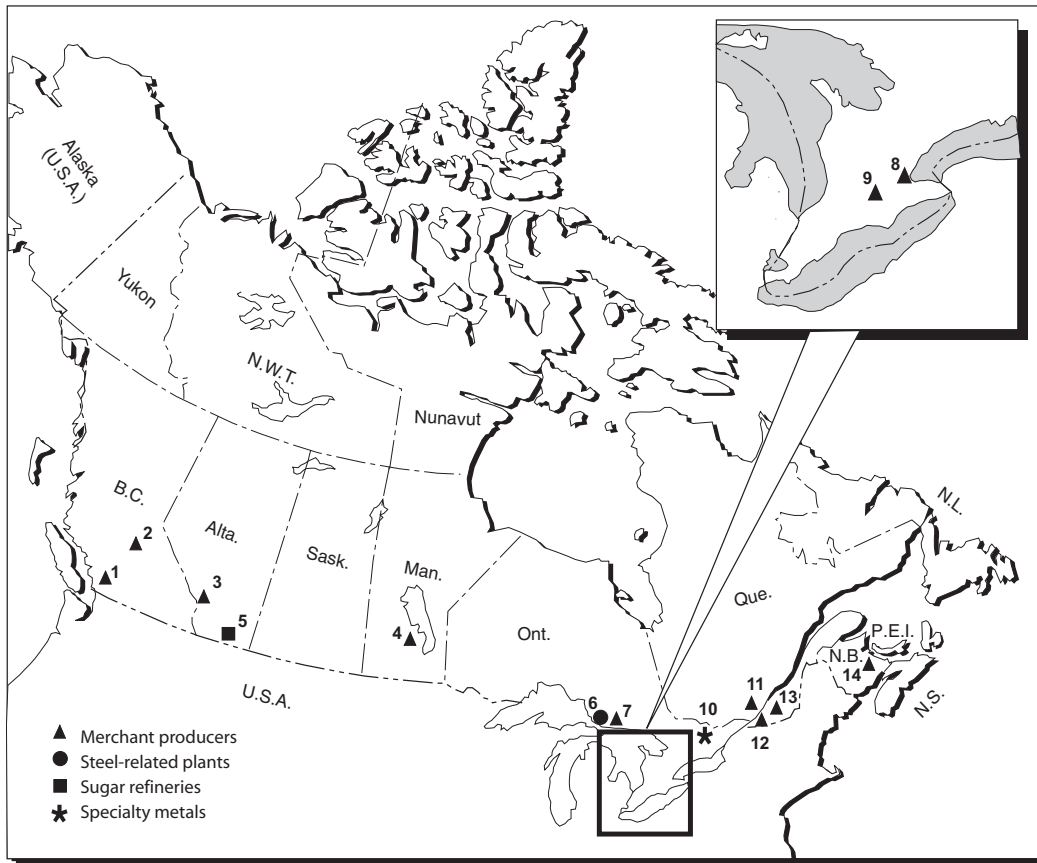
Graymont Limited, a Canadian private company with corporate headquarters in Richmond, British Columbia, operates seven lime plants across Canada, as well as plants and quarries in Ohio, Pennsylvania and northern New York. It is the third largest producer of lime in North America.

In September 2004, Lafarge SA of France announced its intention to divest its 40% stake in Carmeuse North America, the leading producer of lime and owner of three plants in Canada. Carmeuse SA of Belgium, owner of the remaining 60% stake, has agreed to purchase Lafarge's interest. In addition to its Canadian operations, Carmeuse North America has lime plants in Pennsylvania, Ohio, Michigan, Indiana, Illinois and Kentucky. Lafarge indicated that lime is no longer a strategic business for the company.

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.

Development of the Hammerstone project of Birch Mountain Resources came one step closer to reality with the completion of an environmental impact assessment for its Muskeg Valley Quarry located near Fort McMurray, Alberta. The company plans to extract limestone from the quarry for both the construction aggregates market and as feed to a quicklime plant, which would have a capacity of 225 000 t/y in 2008. The company expects demand for lime in the Alberta tar sands projects will increase in the

Figure 1
Lime Producers in Canada, 2004



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, Spragge
8. Lafarge Lime (Canada) Inc., Dundas Division
9. Carmeuse North America, Ingersoll
11. Graymont (QC) Inc., Joliette
12. Graymont (QC) Inc., Bedford
13. Graymont (QC) Inc., Marbleton
14. Graymont (NB) Inc., Havelock

STEEL-RELATED PRODUCERS

6. Algoma Steel Inc., Sault Ste. Marie

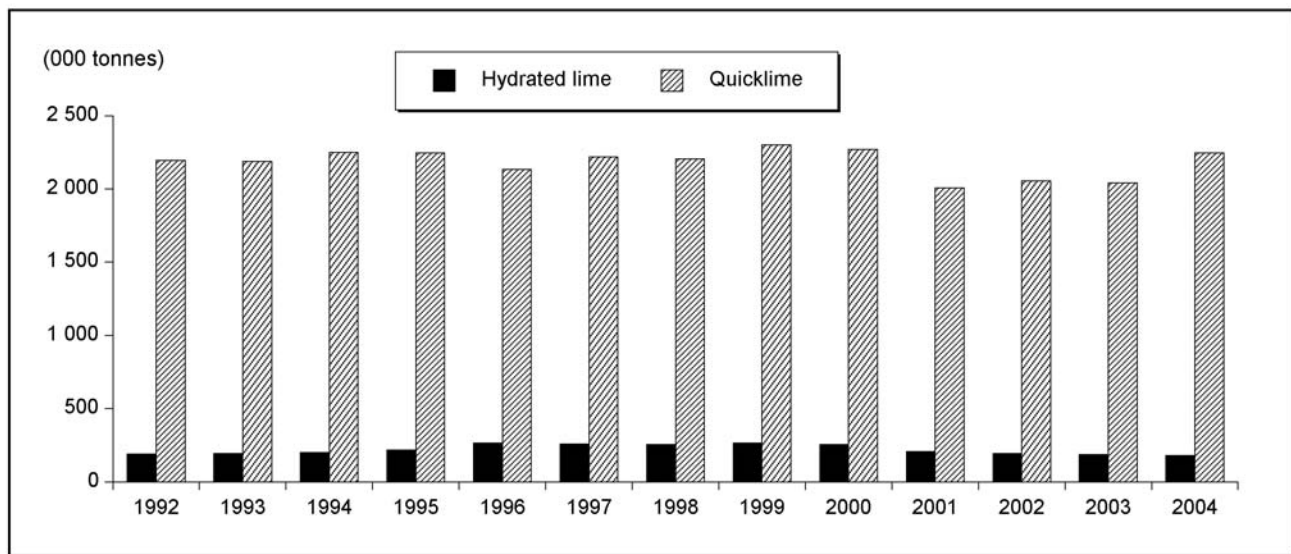
SUGAR REFINERIES

5. Rogers Sugar Ltd., Taber

SPECIALTY METALS

10. Timminco Limited, Haley Station

Figure 2
Canadian Lime Production, 1992-2004



Source: Natural Resources Canada.

coming years, mainly for treatment of process waters used for the steam-assisted gravity drainage (SAGD) process and for SO₂ emission controls in flue gas scrubbing systems.

USE

The use of quicklime, based on reported shipments for the merchant market, amounted to an estimated 2 114 459 t in 2004, compared to 1 868 923 t in 2003. Hydrated lime shipments in the merchant market amounted to an estimated 165 733 t in 2004, compared to 175 573 t in 2003. Hydrated lime is used for environmental control, road construction and soil stabilization, as well as other industrial uses.

Table 4 shows a breakdown of uses for quicklime and hydrated lime in Canada for the period 1997 to 2004. Major uses for lime in Canada continue to be steel-making (44.5%), pulp and paper manufacturing (11.8%), water and sewage treatment (11.9%), and nonferrous metallurgy (10.8%). Figure 3 compares lime use data for 2003 and 2004 in different industrial applications. The trend in recent years has seen an increase in demand for lime in the steel-making and pulp and paper industries, and a slight decrease in the water treatment and nonferrous metallurgy sectors.

Data from the U.S. Geological Survey show lime consumption by major industries in the United States is: metallurgical (35%), environmental (28%), chemical/industrial (23%), construction (13%) and refractory (1%). Lime

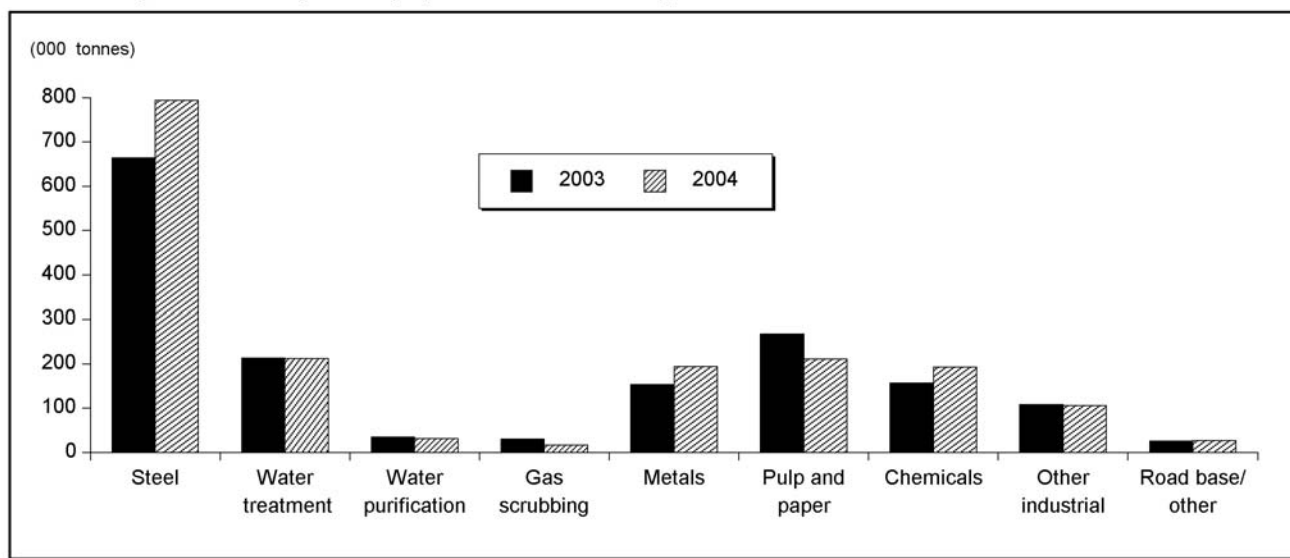
is used in both ferrous and nonferrous metallurgical processes.

In ferrous metallurgy applications (steel-making), lime is used as a flux to remove impurities such as phosphorus and sulphur. Dolomitic quicklime, or dolime, is of particular use in steel-making as it has the additional benefit of prolonging refractory brick life. For nonferrous ores, lime is used in the copper beneficiation process to maintain the proper pH in the flotation process. It is also used in metallurgical processes that extract uranium, gold, nickel and silver, and in paper plants to recover caustic soda in the kraft paper process.

In the environmental sector, lime can be used to control acid mine drainage in the vicinity of metal mine tailings deposits. Lime is important for the treatment of municipal sewage and for the treatment of potable water. Lime is consumed in the flue gas desulphurization (FGD) process at coal-fired generating stations for the control of SO₂ emissions. Other uses for lime include: sugar refining (essentially captive production within the specific industrial plant), the production of precipitated calcium carbonate (PCC), and as an additive in hot-mix asphalt pavements.

In the road-paving industry, new high-performance asphalt mixtures, such as Superpave, use hydrated lime as an anti-stripping agent. Hydrated lime acts to reduce the incompatibility between the bitumen used as a cementing agent and the coarse aggregates. The lime improves the mechanical and chemical bonding properties between the

Figure 3
Lime Use (Quick and Hydrated) by Canadian Industry, 2003 and 2004



Source: Natural Resources Canada.

bitumen and aggregate, reducing rutting and mechanical abrasion. Studies have shown that hydrated lime added to hot-mix asphalt adds 12% to the cost of construction but increases the lifespan of the highway by 38%.

High-calcium quicklime is commercially available in a variety of forms, including lump, crushed, pebble, ground and pulverized. Slaked lime ($\text{Ca}(\text{OH})_2$) is produced by mixing quicklime with water, and it can be purchased as a putty, dry powder or slurry. Aglime, or agricultural lime, is pulverized limestone that is used for soil neutralization.

TRADE

Total lime exports to the United States in 2004 were 136 285 t valued at \$22 million, up from 117 396 t valued at \$21 million in 2003 (Table 1). This represents a 16% increase in export volumes. Canada imported 69 856 t of lime in 2004, compared to 76 271 t in 2003. Figure 4 shows imports and exports of quicklime for the period 1992-2004. Figure 5 shows hydrated lime trade data for the same period. Imports and exports of quicklime and hydrated lime between Canada and 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, is estimated at 121 Mt in 2004, com-

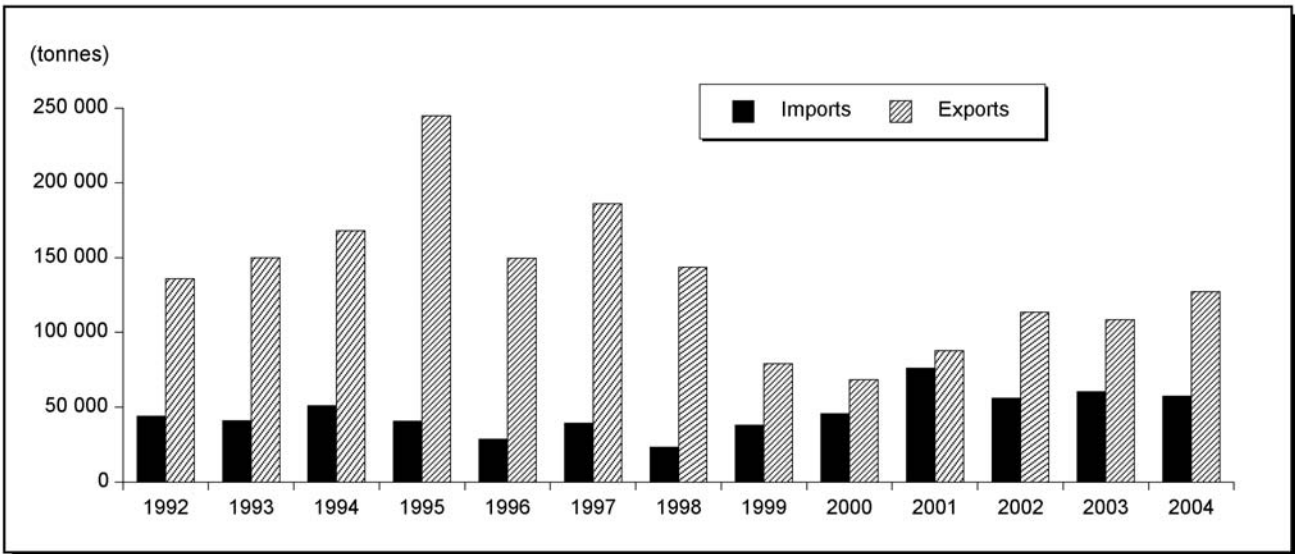
pared to 120 Mt in 2003 (Table 5, Figure 6). Production was led by China (23.5 Mt) followed by the United States (20.4 Mt). Other leading countries included Russia, Japan and Germany with 8.0 Mt, 7.7 Mt and 6.5 Mt, respectively.

The United States produced 20.4 Mt of quicklime and hydrated lime in 2004 from 96 plants, based on data from the U.S. Geological Survey, compared to 19.2 Mt in 2003 from 99 plants. The top five lime producers in the United States are Carmeuse North America, Chemical Lime Company, Graymont Limited, Global Stone Corp., and Martin Marietta Magnesia Specialties LLC. Most U.S. producers operated at higher rates during the year due to an upturn in demand in the steel and flue gas desulphurization markets. Growth has also been reported in the precipitated calcium carbonate and construction sectors. Producers are facing higher energy costs with increased natural gas prices, causing most industry players to switch to coal and petroleum coke for firing kilns. As well, producers are mandated to reduce carbon dioxide intensity by 8% by 2012 as part of an agreement between the National Lime Association and the U.S. Department of Energy.

PRICES

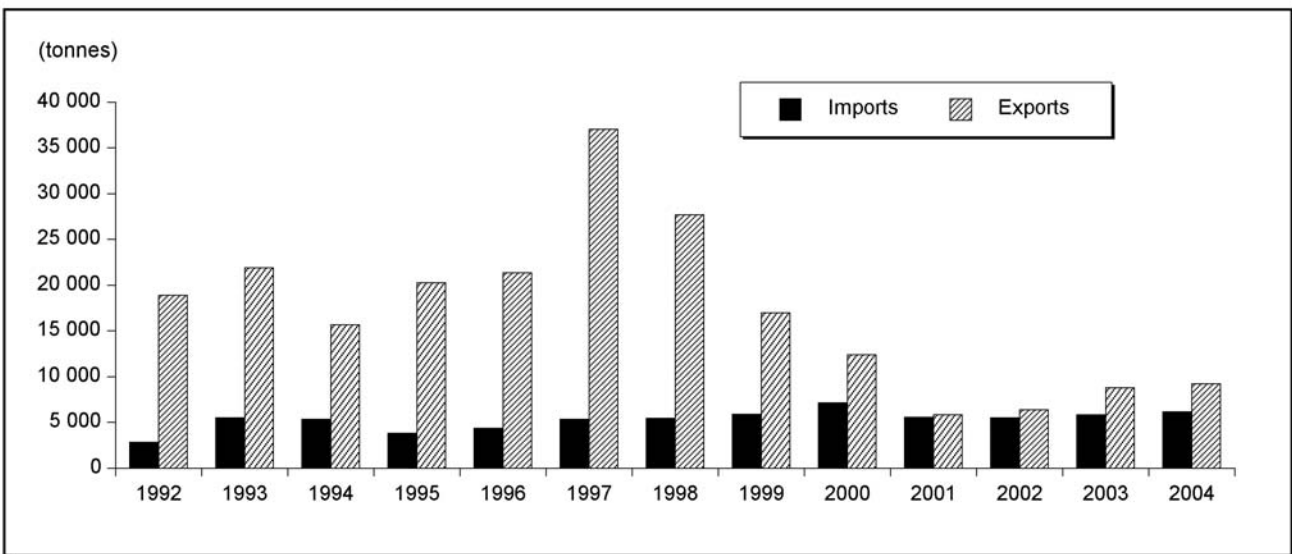
Prices for lime produced in Canada vary according to region, company marketing strategies, and supply and demand forces in effect. The average reported values (f.o.b. plant) for 2004, based on producers' shipments as listed in Table 1, were \$105.57/t for quicklime and

Figure 4
Canadian Quicklime Trade, 1992-2004



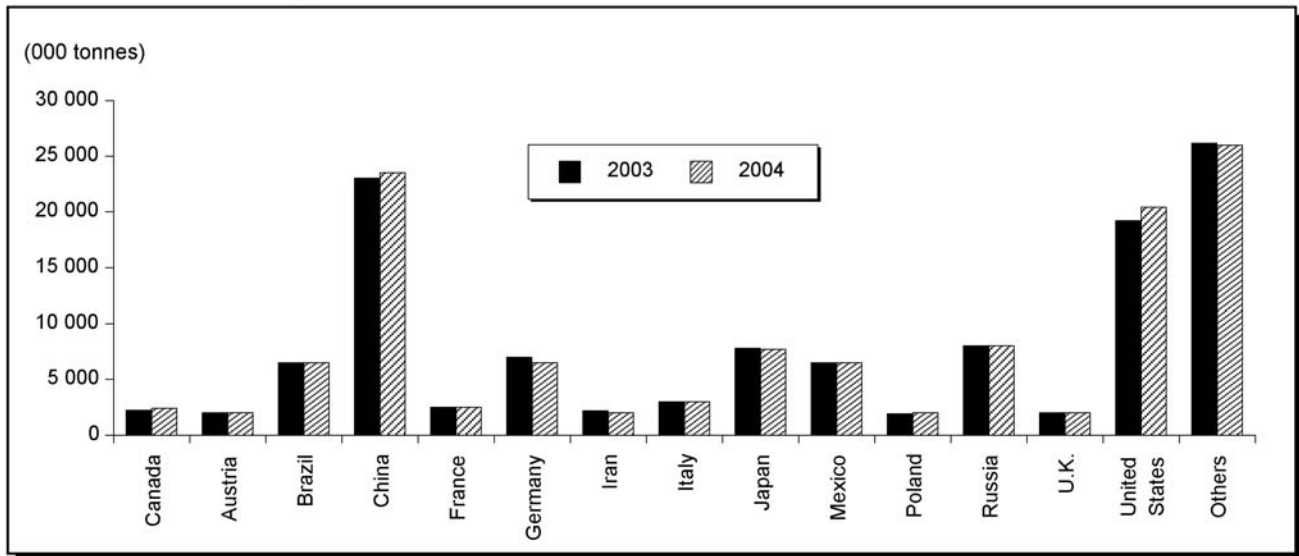
Source: Natural Resources Canada.

Figure 5
Canadian Hydrated Lime Trade, 1992-2004



Source: Natural Resources Canada.

Figure 6
World Lime Production, 2003 and 2004



Source: U.S. Geological Survey.

\$126.26/t for hydrated lime. This represents an increase of 4% for quicklime and 4.6% for hydrated lime. Similar increases have been reported from U.S. producers as companies try to compensate for increases in energy, raw material and labour costs. The U.S. Geological Survey reported an average value of US\$65/t for quicklime and US\$90/t for hydrated lime f.o.b. plant for 2004.

ENERGY AND TECHNOLOGY

Table 3 lists the 14 lime plants in Canada along with kiln capacities and types. Most plants burn a combination of coal and petroleum coke and consume about 6 to 7 gigajoules of energy per tonne of lime produced.

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 through the implementation of CO₂ sequestration processes.

In December 2003, the U.S. Environmental Protection Agency signed the Clean Air Interstate Rule (originally called the Interstate Air Quality Rule), which will regulate the amounts of sulphur dioxide and nitrogen oxide that power plants and other industrial facilities will be allowed to emit by 2015 when the rule will be fully implemented. Emissions of SO₂ will be reduced by as much as 70% in

some states by 2015. Individual states will be required to meet statewide targets. This rule will force some electricity companies to install new flue-gas desulphurization (FGD) equipment and will increase demand for lime in the FGD treatment process.

Duke Power of Charlotte, North Carolina, has started construction of a US\$400 million FGD plant at its 2090-MW Marshall Steam Station at Terrell, North Carolina. The installation is designed to reduce SO₂ emissions by 70% by 2013. Duke Power is spending up to US\$1.5 billion on an environmental retrofit program of 12 units at four power plants in North Carolina. Cinergy Corp. of Cincinnati, Ohio, announced a similar environmental construction program, to cost over US\$2 billion, at several of its coal-fired power plants in Indiana and Ohio.

OUTLOOK

Lime production in Canada is expected to increase slightly in 2005, driven largely by demand in the resurgent steel sector. Higher metal prices in general will also increase demand for lime used in nonferrous metallurgy. With the passing of stricter air emissions regulations in the United States, there may be a modest increase in lime exports from some Canadian plants for use in the flue gas desulphurization process. With continued high demand, prices should also increase moderately in 2005, with quicklime expected to be in the \$110/t range and hydrated lime expected to be around \$125-\$130/t.

NOTE TO READERS

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 30, 2005. (3) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/com_e.html.

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TARIFFS

Item No.	Description	Canada			United States	EU	Japan
		MFN	GPT	USA	Canada	Conventional Rate (1)	WTO (2)
2522.10	Quicklime	Free	Free	Free	Free	1.7%	Free
2522.20	Slaked lime	Free	Free	Free	Free	1.7%	Free
2522.30	Hydraulic lime	Free	Free	Free	Free	1.7%	Free

Sources: Canadian Customs Tariff, effective January 2005, Canada Border Services Agency; Harmonized Tariff Schedule of the United States, 2005; Official Journal of the European Union (October 30, 2004 Edition); Customs Tariff Schedules of Japan, 2004.

(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, LIME PRODUCTION AND TRADE, 2002-04

	2002		2003		2004 (p)	
	(tonnes)	(\$000)	(tonnes)	(\$000)	(tonnes)	(\$000)
PRODUCTION (1)						
By Type						
Hydrated lime	193 089	23 025	185 387	22 665	177 089	22 349
Quick lime	2 054 443	197 506	2 035 611	208 236	2 266 328	239 225
Total	2 247 532	220 532	2 220 998	230 901	2 443 417	261 573
By province						
New Brunswick	x	x	x	x	x	x
Quebec	x	x	x	x	x	x
Ontario	1 121 822	103 205	1 032 353	105 122	1 245 659	132 340
Manitoba	x	x	x	x	x	x
Alberta	x	x	x	x	x	x
British Columbia	x	x	x	x	x	x
Total	2 247 532	220 532	2 220 998	230 901	2 443 417	261 573
EXPORTS						
2518.20	Calcined or sintered dolomite					
	United States	9 785	1 214	9 913	1 151	21 590
2522.10	Quicklime					
	United States	113 458	22 395	108 562	19 756	127 085
2522.20	Slaked lime					
	United States	6 374	969	8 764	1 235	9 196
	Saint Pierre and Miquelon	-	-	-	-	2
	France	2	1	-	-	-
Total		6 376	970	8 764	1 235	9 198
2522.30	Hydraulic lime					
	Jamaica	-	-	16	23	332
	China	66	31	73	28	82
	United States	162	61	70	12	4
	Singapore	-	-	-	-	4
	Trinidad and Tobago	-	-	21	17	-
Total		228	92	180	80	422
Total exports		129 847	24 671	127 419	22 222	158 295
						24 883

TABLE 1 (cont'd)

		2002		2003		2004 (p)	
		(tonnes)	(\$000)	(tonnes)	(\$000)	(tonnes)	(\$000)
IMPORTS (2)							
2518.20	Calcined or sintered dolomite						
	United States	46 590	6 938	48 774	6 462	52 861	6 747
	Italy	25	18	—	—	—	—
	Total	46 615	6 956	48 774	6 462	52 861	6 747
2522.10	Quicklime						
	United States	55 529	6 753	59 916	6 282	57 083	6 349
	Canada	18	3	87	15	106	29
	Switzerland	100	18	159	17	98	16
	India	6	1	3	...	1	...
	France	—	—	—	—	3	...
	United Kingdom	406	70	—	—	—	—
	Total	56 059	6 845	60 165	6 314	57 291	6 394
2522.20	Slaked lime						
	United States	5 459	1 281	5 805	1 233	6 113	1 198
	Israel	—	—	—	—	30	5
	Germany	5	2	4	1	9	3
	France	1	...	—	—	—	—
	Total	5 465	1 283	5 809	1 234	6 152	1 206
2522.30	Hydraulic lime						
	United States	8 505	1 479	10 550	1 888	6 660	1 254
	France	289	95	1 748	475	966	248
	Italy	—	—	—	—	1	...
	Germany	5	2	—	—	—	—
	United Kingdom	1	...	5	2	—	—
	Total	8 800	1 576	12 303	2 365	7 627	1 502
	Total imports	116 939	16 660	127 051	16 375	123 931	15 849

Sources: Natural Resources Canada; Statistics Canada.

— Nil; ... Amount too small to be expressed; (p) Preliminary; 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, 1988-2004

	Production (1)			Imports	Exports	Apparent Use (2)
	Quick	Hydrated	Total			
(tonnes)						
1988 (a)	2 306 831	211 151	2 517 982	32 543	122 899	2 427 626
1989	2 349 312	202 622	2 551 934	39 096	83 607	2 507 423
1990	2 137 996	202 741	2 340 737	43 715	138 410	2 246 042
1991	2 184 836	190 424	2 375 260	45 011	134 405	2 285 866
1992	2 193 752	190 592	2 384 344	55 706	173 249	2 266 801
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	66 885	193 902	2 322 006
1995	2 244 800	216 916	2 461 716	52 883	266 476	2 248 123
1996	2 134 437	267 595	2 402 032	36 640	216 849	2 221 823
1997	2 219 385	257 186	2 476 571	47 382	224 233	2 299 720
1998	2 204 957	256 086	2 461 043	34 031	171 447	2 323 627
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	80 630	2 507 035
2001	2 007 078	205 568	2 212 646	94 150	93 516	2 213 280
2002	2 054 443	193 089	2 247 532	70 324	120 062	2 197 794
2003	2 035 611	185 387	2 220 998	78 277	117 505	2 181 770
2004 (p)	2 266 328	177 089	2 443 417	71 069	136 705	2 377 781

Sources: Natural Resources Canada; Statistics Canada.

(p) Preliminary.

(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, 2004

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, 1997-2004

End Uses	1997	1998	1999	2000	2001	2002	2003	2004
(tonnes)								
CHEMICAL AND INDUSTRIAL								
Steel-making	807 000	707 482	780 877	632 284	530 605	730 180	664 225	793 839
ENVIRONMENTAL								
Water and sewage treatment	278 986	310 510	296 053	224 074	197 817	233 036	213 391	211 881
Water purification	52 026	48 366	51 323	37 445	48 420	38 590	34 320	31 541
Gas scrubbing	9 376	15 060	16 309	7 629	6 742	22 803	30 229	16 676
Total environment	340 389	373 936	363 686	269 148	252 979	294 429	277 940	260 098
Metal concentration	151 258	158 482	138 431	153 469	176 213	141 434	152 563	193 348
Pulp and paper mills	225 363	200 824	213 627	218 878	253 287	240 646	267 072	211 214
Chemicals	126 375	193 693	194 362	161 408	163 070	167 952	156 005	192 121
Other industrial uses	73 879	96 416	101 102	109 645	44 765	88 500	108 344	105 897
CONSTRUCTION								
Road and soil stabilization	12 458	14 323	15 810	x	x	x	x	x
Mason and finishing lime	x	x	x	x	x	x	x	x
Other	13 851	17 807	22 126	11 259	x	3 754	7 351	8 933
AGRICULTURE								
	x	x	x	4 699	x	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	1 783 136

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, 1998-2004

	1998	1999	2000	2001	2002	2003	2004 (p)
	(000 tonnes)						
Canada	2 460	2 570	2 500	2 210	2 248	2 221	2 443
Brazil	5 700	5 700	5 700	6 300	6 300	6 500	6 500
China	21 000	21 500	21 500	22 000	22 500	23 000	23 500
France	2 800	2 400	2 400	2 400	2 500	2 500	2 500
Germany	7 600	7 600	7 600	7 000	7 000	7 000	6 500
Italy (1)	3 500	3 500	3 500	3 500	3 000	3 000	3 000
Japan (2)	8 100	7 750	7 700	8 100	8 050	7 800	7 700
Mexico	6 600	6 600	6 600	6 500	6 500	6 500	6 500
Poland	2 500	2 500	2 500	2 200	2 000	1 900	2 000
Russia	(3)	(3)	(3)	8 000	8 000	8 000	8 000
United Kingdom	2 500	2 500	2 500	2 500	2 000	2 000	2 000
United States	20 100	19 600	19 600	18 900	17 900	19 200	20 400
Other countries	33 050	33 650	33 995	28 056	28 002	30 379	29 957
Total	115 910	115 870	116 095	117 666	116 000	120 000	121 000

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

(p) Preliminary.

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