

# Sulphur

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## HIGHLIGHTS

Preliminary figures show Canadian sulphur production was 9 Mt in 2003, a similar level to 2002. Elemental sulphur accounted for 8 Mt, mainly from the production of natural gas, and the remainder was derived from oil refining and oil sands production. An additional 1 Mt of sulphur, in the form of sulphuric acid and liquefied sulphur dioxide, was recovered from the smelting of metals. Alberta, British Columbia and Saskatchewan are the main producing provinces. Other provinces produce limited amounts of sulphur from oil refining and metals smelting.

Canada exported approximately 8 Mt of sulphur in 2003, including 7.4 Mt of elemental sulphur and 0.6 Mt of sulphur in other forms (SOF). Exports to offshore were estimated at 5.4 Mt.<sup>1</sup> Exports to the United States amounted to 2.6 Mt, including 2 Mt of elemental sulphur and 0.6 Mt of SOF, mainly sulphuric acid<sup>2</sup> (1.8 Mt H<sub>2</sub>SO<sub>4</sub>) in 2003.

## CANADIAN DEVELOPMENTS

Canada is currently ranked second in world sulphur production behind the United States. Canada's sulphur production peaked in 2000 with total output close to 10 Mt of sulphur in all forms (SAF). Production has declined since then to 9.4 Mt in 2001, 8.9 Mt in 2002, and 9 Mt in 2003. The decline was mainly in elemental sulphur production. Sulphur recovered from metal smelters and petroleum refineries remained relatively stable.

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<sup>1</sup> The trade numbers used are from industry, which differ from Statistics Canada's numbers.

<sup>2</sup> One tonne of sulphuric acid (H<sub>2</sub>SO<sub>4</sub>) contains approximately 33% of sulphur.

Elemental sulphur recovered from natural gas processing has decreased in Alberta and British Columbia as Canada's natural gas reserves are decreasing. Alberta's production from gas plants decreased 2% while British Columbia's gas processing was down 11% in 2003. However, elemental sulphur recovered from natural gas processing remained in a dominant position, accounting for 70% of total elemental sulphur output, with the remainder arising from oil sands production. Output from oil sands production increased constantly in the past three years, 30% each year on average, and the volume increased from 755 000 t in 2001 to 1 100 000 t in 2003.

Canada's sulphuric acid (H<sub>2</sub>SO<sub>4</sub>) was mainly recovered from metal smelting operations and was also converted from elemental sulphur for the production of phosphate fertilizers. In 2003, Canada produced 4.1 Mt of sulphuric acid, down from 4.4 Mt in 2002. Production from metal smelters was 2.5 Mt, down from 2.8 Mt, due to shut-downs and labour disputes. Production from elemental sulphur was 1.5 Mt, relatively the same as in 2002.

Canada has built up a huge storage of sulphur blocks over the years. At the end of 2003, the storage was estimated at 14 Mt, of which Syncrude Canada Ltd. alone had 5.3 Mt. Most sulphur output from oil sands production in Fort McMurray, Alberta, was formed and put into storage due to the high cost of transportation.

In 2003, western Canadian producers remelted some 900 000 t of the sulphur storage block to supply mainly the U.S. market.

## CONSUMPTION

Canada's sulphur consumption is relatively small. Domestic demand for elemental sulphur was 700 000 t in 2003, of which half was converted to sulphuric acid to produce fertilizers. Canada's sulphuric acid consumption was 2.4 Mt in 2003. Agricultural fertilizer production consumed about 1 Mt and the remaining 1.4 Mt was consumed by the pulp and paper industry, industrial inorganic chemicals producers, and some other 15 industries.

## TRADE

Canada exports more than 90% of its sulphur output to about 20 countries. Exports to offshore markets account for more than 70% of total exports. Exports to offshore markets were fluctuating in the past four years from 5.4 Mt in 2000 down to 5.2 Mt in 2001 and 5.1 Mt in 2002, and then recovered in 2003 to 5.4 Mt. The losses were due to decreased imports from Israel, Mexico, Morocco and other importing countries. However, export increases to China, Brazil, Australia and South Africa replaced the lost volume and returned Canada's exports to the 2000 level. Exports to China increased from 1.7 Mt in 2000 to 2.3 Mt in 2003, accounting for more than 40% of Canada's exports to offshore markets. The Chinese markets became an important destination for Canadian producers.

Elemental sulphur exports to the United States increased from 1.2 Mt in 2001 to 1.9 Mt in 2002 and 2.1 Mt in 2003. Canada also exported sulphuric acid and a small amount of sulphur dioxide to the United States. Sulphuric acid exports to the United States were 1.9 Mt in 2001, 2 Mt in 2002 and 1.8 Mt in 2003.

Canadian sulphur imports continued to be minimal and were mostly from the United States.

## PRICES

In 2003, the sulphur price was driven up due to worldwide demand increases. At the beginning of 2003, quoted sulphur contract prices f.o.b. Vancouver were between US\$38 and \$55/t. Prices kept rising during the year. At the end of June prices climbed to US\$52-\$80/t and, at the end of 2003, they were between US\$54 and \$65/t. Entering 2004, prices were at US\$60-\$65/t and remained at that level until the end of May.

High demand for ocean vessels drove up ocean freight rates significantly in 2003. At the beginning of the year, the freight rate for Panamax vessels between Vancouver and China was US\$12/t. By August, the rate was up to US\$22-\$24/t. At the end of 2003, the rate was US\$33-\$35/t. The freight rate increased to US\$40-\$42/t at the beginning of 2004 and remained the same to the end of April. The freight rate hike may have an impact on mid-term sulphur consumption and imports as the increased freight rates pushed up the cost for sulphur importers.

## WORLD OVERVIEW AND OUTLOOK

About 80 countries around the world produce all forms of sulphur. In 2003, total world sulphur production in all forms was 66 Mt. North America led the output at 20 Mt. The world's largest producer, the United States,

accounted for 11 Mt and the second largest producer, Canada, accounted for 9 Mt. Eastern Europe, also referred to as the former Soviet Union (FSU), produced 9.5 Mt, of which 6.7 Mt was produced by Russia, the world's third largest producer. Asia (excluding China), the Middle East and Western Europe produced 7.4 Mt, 7.3 Mt and 7.6 Mt, respectively. China alone produced 6.4 Mt, ranking it the fourth largest producer in the world. Latin America produced 4.5 Mt.

World production of sulphur in all forms is expected to grow at 2.5% per year over the next five years (2004-2008). Most increases will occur in the Middle East and the FSU, as well as in Latin America and Asia. World sulphur production will reach approximately 74 Mt in 2008.

The consumption of sulphur in all forms is expected to increase to 72 Mt from the current 63 Mt. The increases will mainly come from Asia, especially China and India, and from Latin America. Most sulphur demand increases are derived from the demand for phosphate fertilizers production. Demand for sulphuric acid for use in fertilizer will increase from the current 107 Mt to 115 Mt in 2008. The demand for non-fertilizer uses will grow to 86 Mt in 2008 from the current 77 Mt. The total demand for sulphuric acid will increase to 201 Mt in 2008 from the current 178 Mt.

China's sulphur consumption increased significantly in the past five years driven by China's self-sufficient policy in phosphate fertilizers. China itself is a large sulphur producer and ranks fourth in the world. However, China produces a limited quantity of elemental sulphur. Its production is mainly sulphur in other forms (SOF). In fact, China is the world's largest producer of SOF. China uses all available domestic sources to meet its internal demand, but demand exceeds supply. Sulphur imports are critical for the growing demand in China. Imports of sulphur in all forms increased from 2 Mt in 1999 to 5.1 Mt in 2003, an increase of 150% in five years. For the past three years, China has been the world's largest importer of sulphur in all forms and this trend is forecast to continue.

Canada is the largest supplier of elemental sulphur to China. In 2003, Canada provided 2.3 Mt of elemental sulphur to China, accounting for more than half its total elemental sulphur imports (4.1 Mt).

China also imported elemental sulphur from five countries of the Middle East, including the United Arab Emirates, Saudi Arabia, Iran, Kuwait and Qatar. These five countries' exports to China are growing at an amazing rate. The combined five countries' exports to China were 90 000 t in 1999, 800 000 t in 2002 and 1.4 Mt in 2003, a fifteenfold increase in five years. The trend is expected to continue.

India is another country whose fertilizer consumption is constantly increasing. The required sulphur content in

phosphate fertilizers production is limited in supply. India imports sulphur to meet domestic demand for fertilizer production. Although its demand for sulphur may not be as high as China's, India's demand is growing.

The world's elemental sulphur trade increased 13.8% in 2002 and 10.3% in 2003. It is expected to increase an additional 10% in 2004. For the next five years, trade is expected to increase at an average of 5% per year.

The fastest-growing regions for elemental sulphur exports are the Middle East and the FSU. Exports from five Middle Eastern countries (the United Arab Emirates, Saudi Arabia, Iran, Kuwait and Qatar) increased 14% in both 2002 and 2003. Russia's exports jumped up significantly in 2002 and increased 23% in 2003. It is expected that exports from these two regions will continue to increase at the current or a higher rate.

More than half of the world's sulphuric acid trade was short-haul regional trade within Europe, Asia and North America. Worldwide trade was up 7% in 2003. It is expected that trade will grow in Asia, largely due to China's demand. The supply may be tight, however, due to smelter closures in Western Europe.

Canadian sulphur production is expected to be on a downward trend until 2008-10, probably declining by 1.7% per year. The main reason for the decline is that Canada's natural gas reserves continue to decrease. Although part of the decline will be offset by the sulphur recovered from oil sands production, it probably will not pick up all of the decline until 2008. It is expected that Canadian exports will be at a level similar to the 2003 level for the next few years.

## GENERAL INFORMATION

Sulphur is a nonmetallic element that occurs in both combined and free states and is widely distributed over the earth's surface. It is tasteless, odourless, insoluble in water, and often occurs in yellow crystals. It is the 16th most abundant element in nature and the fourth most important plant nutrient.

Sulphur contained in ores that can be mined is referred to as native sulphur. Native sulphur is limited in quantity. Sulphur is abundant in sulphide minerals such as copper, iron, lead and zinc, and can be recovered as sulphuric acid from metal smelting. Sulphur also occurs in many liquid and gaseous hydrocarbons that can be recovered as by-products from natural gas and oil sands production and from the oil refining process.

Sulphur production can be traced back for centuries. The use of the Frasch process in the late 1800s, a technique to mine underground native sulphur, was generally consid-

ered to be the beginning of the sulphur industry. Since the 1950s, sulphur recovery from natural gas processing and petroleum refining was gradually replacing Frasch sulphur to the point that, by the 1980s, it became the world's main supplying source.

The principal use of all sulphur in the world is as a process agent in the manufacture of fertilizers such as superphosphates, ammonium phosphate and ammonium sulphate. The fertilizer industry uses more than half of the sulphur production, converting most of it into sulphuric acid to produce fertilizers. The second-largest consuming sector is the chemical industry where sulphur is used as sulphuric acid in products ranging from pharmaceuticals to synthetic fibres. Other consumers of sulphur include manufacturers of pulp and paper, iron and steel, nonferrous metals, and titanium dioxide pigments. These industries also use sulphur in the form of sulphuric acid. Overall, 90% of worldwide sulphur consumption is in the form of sulphuric acid.

The remaining 10% of worldwide sulphur consumption is in non-acid form. Sulphur is directly used as fertilizer to enrich soils. Manufactured products that require sulphur in non-acid form in their production include insecticides and fungicides, pulp and paper, photographic supplies, leather products, rayon and rubber.

*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, 2004. (3) This and other reviews, including previous editions, are available on the Internet at [www.nrcan.gc.ca/mms/cmty/com\\_e.html](http://www.nrcan.gc.ca/mms/cmty/com_e.html).*

## NOTE TO READERS

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**TARIFFS**

Item No.	Description	Canada			United States
		MFN	GPT	USA	Canada
2503.00.00	Sulphur of all kinds, other than sublimed sulphur, precipitated sulphur and colloidal sulphur				
2503.00.00.10	Crude or unrefined sulphur	Free	Free	Free	Free
2503.00.00.90	Other	Free	Free	Free	Free
2802.00.00	Sulphur, sublimed or precipitated; colloidal sulphur	Free	Free	Free	Free
2807.00.00	Sulphuric acid; oleum	Free	Free	Free	Free
2811.23.00	Sulphur dioxide	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, SULPHUR SHIPMENTS AND PRODUCTION, 2001-03**

	2001		2002		2003	
	(tonnes)	(\$000)	(tonnes)	(\$000)	(tonnes)	(\$000)
<b>SHIPMENTS (1)</b>						
Sulphur in smelter gases (2)	1 075 939	47 703	1 077 992	38 896	875 172	45 509
Elemental sulphur (3)	7 041 920	6 170	6 672 721	68 881	7 291 680	226 263
Total sulphur content (2)	8 117 859	53 873	7 750 713	107 777	8 166 852	271 772
<b>PRODUCTION (1)</b>						
Sulphur in smelter gases (2)	1 124 099	..	1 109 334	..	968 971	..
Elemental sulphur (3)	8 319 684	..	7 815 903	..	8 061 307	..
Total sulphur content (2)	9 443 783	..	8 925 237	..	9 030 278	..

Sources: Natural Resources Canada; Statistics Canada.

.. Not available.

(1) Data compiled regardless of origin (i.e., domestic and foreign source materials). (2) Sulphur in liquefied SO<sub>2</sub> and H<sub>2</sub>SO<sub>4</sub> recovered from the smelting of metallic sulphides and from the roasting of zinc sulphide concentrates. (3) Producers' shipments of elemental sulphur produced from natural gas; also included are small quantities of sulphur produced in the refining of domestic crude oil and synthetic crude oil.

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

**TABLE 2. CANADA SULPHUR PRODUCTION AND SHIPMENTS, 1994-2003**

	Production			Shipments (1)		
	Elemental Sulphur	In Smelter Gases	Total Production	Elemental Sulphur	In Smelter Gases	Total Shipments
(000 tonnes)						
1994	7 975	1 048	9 023	5 791	1 026	6 817
1995	7 935	1 083	9 018	7 089	1 074	8 163
1996	8 446	1 044	9 490	7 433	1 033	8 466
1997	8 407	1 073	9 480	7 901	1 061	8 962
1998	8 542	1 153	9 695	7 406	1 048	8 454
1999	8 812	1 160	9 972	8 144	1 073	9 217
2000	8 779	1 167	9 946	8 089	1 138	9 227
2001	8 320	1 124	9 444	7 042	1 076	8 118
2002 (r)	7 816	1 109	8 925	6 673	1 078	7 751
2003 (p)	8 061	969	9 030	7 292	875	8 167

Source: Natural Resources Canada.

(p) Preliminary; (r) Revised.

(1) Shipments data compiled regardless of origin (i.e., domestic and foreign source materials).

**TABLE 3. CANADA, SULPHURIC ACID PRODUCTION, TRADE AND APPARENT CONSUMPTION, 1990-2003**

	Production	Imports (1)	Exports (1)	Apparent Consumption (2)
(tonnes, 100% acid)				
1990	3 829 570	71 319	1 280 502	2 620 387
1991	3 675 839	79 207	1 265 740	2 489 306
1992	3 776 086	86 284	1 340 213	2 522 157
1993	3 958 416	95 806	1 629 054	2 425 168
1994	4 055 165	68 261	1 645 406	2 478 020
1995	4 276 383	70 816	1 732 522	2 614 677
1996	4 355 592	76 016	1 858 561	2 573 047
1997	4 314 773	95 552	1 857 902	2 552 423
1998	4 590 056	129 201	2 081 324	2 637 933
1999	4 282 151	138 807	1 986 068	2 434 890
2000	4 440 812	158 149	2 125 740	2 473 221
2001	4 056 948	162 637	1 872 643	2 355 942
2002	4 423 865	128 102	1 970 566	2 581 401
2003 (p)	4 065 821	170 183	1 765 770	2 470 234

Source: Natural Resources Canada, compiled from the reports of producing companies.

(p) Preliminary.

(1) Imports and exports include HS code 2807.00. (2) Production plus imports, less exports.

**TABLE 4. CANADA, SULPHURIC ACID, REPORTED CONSUMPTION BY END USE, 2000-2003**

End Use	2000 (a)	2001 (p,a)	2002 (p,a)	2003 (p,a)
(tonnes)				
Agricultural chemicals and fertilizers	940 940	995 744	1 110 325	1 013 001
Pulp and paper	551 802	452 088	608 733	588 012
Industrial inorganic chemicals	512 106	363 060	348 115	456 604
Nonferrous smelting and refining	111 786	127 548	188 216	116 787
Uranium mines	x	x	x	x
Crude and refined petroleum products	x	x	31 030	10 443
Other mines, metal and nonmetal	x	x	37 833	x
Soap and cleaning compounds	x	x	x	x
Metal rolling and extruding	12 292	x	x	x
Electrical products	4 101	x	x	x
Food, brewery and distillery	2 801	1 780	x	x
Leather and textile	-	-	x	x
Plastics and synthetic resins	x	-	-	-
Other end uses	54 593	52 968	116 169	98 240
Total (1)	2 316 070	2 153 984	2 517 385	2 382 580

Source: Natural Resources Canada, compiled from the reports of producing companies.

- Nil; (p) Preliminary; x Confidential.

(a) Confidential numbers are included in the total.

(1) Reported consumption does not include imported acid.

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

TABLE 5. WORLD PRODUCTION OF SULPHUR BY SELECTED COUNTRIES, 2000-2003

	2000		2001		2002		2003	
	All Forms (1)	Elemental	All Forms (1)	Elemental	All Forms (1)	Elemental	All Forms (1)	Elemental
(000 tonnes sulphur/sulphur-equivalent)								
<b>WESTERN EUROPE</b>								
Finland	770	46	667	46	668	55	719	61
France	1 042	781	1 096	835	1 040	792	904	709
Germany	2 668	1 735	2 779	1 750	2 816	1 745	2 736	1 661
Italy	643	469	676	502	703	545	699	565
Netherlands	542	428	494	385	464	359	497	384
Spain	908	302	843	295	858	304	854	306
Others	1 176	695	1 220	643	1 244	647	1 237	683
Total, Western Europe	7 749	4 456	7 775	4 456	7 793	4 447	7 646	4 369
<b>CENTRAL EUROPE</b>								
Poland	1 764	1 480	1 352	1 056	1 221	940	1 215	918
Others	490	194	510	209	561	222	609	228
Total, Central Europe	2 254	1 674	1 862	1 265	1 782	1 162	1 824	1 146
<b>FORMER SOVIET UNION</b>								
	8 219	6 716	8 710	7 178	9 134	7 580	9 522	7 940
<b>AFRICA</b>								
	562	226	633	285	721	315	757	340
<b>NORTH AMERICA</b>								
Canada	9 805	8 734	9 348	8 305	9 224	8 190	9 024	8 138
United States	11 450	9 280	10 406	8 270	10 491	8 481	10 869	8 920
Total, North America	21 255	18 023	19 754	16 575	19 715	16 671	19 892	17 058
<b>LATIN AMERICA</b>								
Chile	1 135	25	1 238	25	1 265	25	1 497	25
Mexico	1 329	851	1 433	878	1 360	887	1 475	1 032
Venezuela	370	370	395	395	500	500	550	550
Others	967	454	934	389	903	392	957	426
Total, Latin America	3 801	1 700	4 000	1 687	4 028	1 804	4 479	2 033
<b>MIDDLE EAST</b>								
Iran	920	920	995	995	1 200	1 200	1 405	1 405
Kuwait	512	512	524	524	634	634	714	714
Saudi Arabia	2 101	2 101	2 345	2 345	2 364	2 364	2 600	2 600
United Arab Emirates	1 100	1 100	1 490	1 490	1 605	1 605	1 660	1 660
Others	1 093	985	1 163	1 045	1 112	993	883	765
Total, Middle East	5 726	5 618	6 517	6 399	6 915	6 796	7 262	7 144
<b>ASIA</b>								
China	6 987	290	7 004	310	6 609	335	6 412	420
India	579	215	833	415	963	465	1 024	515
Japan	3 658	2 071	3 564	2 024	3 478	1 865	3 503	1 951
South Korea	1 256	690	1 381	700	1 400	670	1 486	700
Others	1 322	833	1 370	841	1 373	851	1 399	858
Total, Asia	13 802	4 099	14 152	4 290	13 823	4 186	13 824	4 444
<b>OCEANIA</b>								
	674	61	930	71	975	75	973	80
Total world	64 042	42 573	64 333	42 206	64 886	43 036	66 179	44 554

Source: British Sulphur Consultants.

(1) All Forms include elemental sulphur, sulphur contained in pyrites, and sulphur recovered from metallurgical waste gases, mostly in the form of sulphuric acid.

Note: Only countries with over 500 000 tonnes of sulphur production were selected.