Sulphur

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HIGHLIGHTS

- Sulphur is a nonmetallic element used principally in the manufacture of fertilizers and in the production of chemicals, pulp and paper, and in metallurgical operations.
- In Canada, the majority of elemental sulphur is obtained as a by-product of natural gas production. However, sulphur recovered from oil sands production is increasing concurrent with development of the oil sands.
- Global production of sulphur in all forms is forecast to increase from 75 Mt in 2008 to 91.4 Mt by 2012, exceeding demand by some 4.1 Mt.
- The price of elemental sulphur experienced a turbulent ride in 2008, hitting a high of US$840/t and a low of US$35/t.

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 4th 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. It 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 considered to be the beginning of the sulphur industry. Since the 1950s, sulphur recovery from natural gas processing and petroleum refining had been gradually replacing Frasch sulphur to the point that, by the 1980s, it had become 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 and sulphuric acid include manufacturers of pulp and paper, iron and steel, nonferrous metals, and titanium dioxide pigments. 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.

CANADIAN DEVELOPMENTS

Preliminary figures show Canadian sulphur production was roughly 8.1 Mt in 2008, an 8% decrease compared to 8.8 Mt in 2007. The decrease was from natural gas processing. Canadian elemental sulphur output in 2008 was 6.9 Mt, a decrease of 6.9% compared to 7.6 Mt in 2007. An additional 1.1 Mt of sulphur equivalent, in the form of sulphuric acid and liquefied sulphur dioxide, was recovered from the smelting of metals.

Canada exported approximately 7.6 Mt in 2008, a decline of 5.2% compared to 8 Mt in 2007. The decline occurred in elemental sulphur with exports of 6.8 Mt in 2008, down 6.4% from 7.3 Mt in 2007. Exports of sulphur in other forms (SOF) amounted to 776 000 t of sulphur equivalent.

Exports to offshore markets were 4.7 Mt in 2008, a 10% decline compared to 5.2 Mt in 2007. The majority of the decline was in exports to China with shipments of 1.9 Mt in 2008, compared to 2.7 Mt in 2007. Exports to other offshore destinations increased roughly 10%, partially offsetting the export loss to China. Exports to the United States remained at levels comparable to 2007.

Canadian sulphur production was concentrated in the western provinces of Alberta, British Columbia, and Saskatchewan. Other provinces produced limited amounts of sulphur from oil refining and metals smelting.

Elemental sulphur is mainly recovered from natural gas processing in Alberta and a limited amount is also recovered in British Columbia. Although natural gas remained the main source for elemental sulphur production, it is expected to decline in the coming years as gas reserves are decreasing and no new reserves or resources have been identified. Sulphur recovered from oil sands processing is expected to increase in the future. Sulphur recovered from oil refining is limited in Canada and production has remained stable over the last several years.

Sulphur recovered from metal smelting operations, mainly in the form of sulphuric acid (H_2SO_4), was 1.1 Mt of sulphur equivalent[1] in 2008. More than half of the sulphur recovered from smelters was sold to the United States (2.3 Mt of H_2SO_4) and the remainder was consumed domestically in the production of fertilizer, pulp and paper, industrial chemicals, and other minor applications.

Canada has built up a huge sulphur inventory over the years, mainly in the form of sulphur blocks located in Alberta. The Alberta Energy and Utilities Board (AEUB) recorded a sulphur inventory of 11.5 Mt at the end of 2008, which was down approximately 300 000 t from 11.8 Mt in 2007. Most of this inventory (estimated at more than 8 Mt) belonged to Syncrude Canada Ltd. in Fort McMurray, Alberta. Logistical difficulties, particularly the lack of railway access, continued to be a major obstacle for sulphur to be shipped out of Alberta's oil sands processing sites.

Oil sand is a mixture of sand, clay, water, and bitumen, which is a black, asphalt-like hydrocarbon described as being "thick as molasses." Oil sands contain roughly 18% bitumen. Bitumen contains roughly 5% sulphur. There is about 0.1% sulphur contained in synthetic crude oil, which is further recovered in the refining process.

Sulphur is mainly recovered from the upgraders that process mined oil sands. Preliminary statistics indicate that approximately 1.417 Mt of elemental sulphur were recovered from processing mined oil sands in 2008. As oil sands upgrading capacity is increasing in Alberta, this becomes a leading indicator of increased sulphur recovery. It is forecast that sulphur output will increase to about 3 Mt/y by 2015 and 4 Mt/y by 2020.

In 2008, Canada produced approximately 4.5 Mt of sulphuric acid (H_2SO_4), a 5% increase over the 4.3 Mt produced in 2007. Production from metal smelters was 3.3 Mt of H_2SO_4 in 2008, almost the same output as in 2007. Sulphuric acid production from elemental sulphur was estimated at 1.2 Mt H_2SO_4 in 2008, a slight increase compared to the 1.1 Mt produced in 2007.

Over the years, increased measures to improve overall environmental performance and reduce sulphur emissions have resulted in greater capture of sulphur, which in turn contributes to increased sulphur production.

PRICES AND FREIGHT

Export prices for sulphur experienced a turbulent market throughout 2008. The sulphur contracts price free on board Vancouver reached a high of US$840/t in July, August, and September, but then fell dramatically to a low of US$40/t in November.

Ocean freight rates for shipping sulphur from Vancouver to China also reflected the sulphur demand trend.

INTERNATIONAL DEVELOPMENTS

About 80 countries around the world produce sulphur in all forms (SAF). In 2008, total global production of SAF was approximately 73.4 Mt, a 2.8% increase from the previous year's 71.4 Mt. China was the world's largest sulphur producer with a total of 11.7 Mt of SAF in 2008, a 9.3% increase from 10.7 Mt in 2007. Sulphur output increased in almost all geographic regions except Western Europe, where output was slightly lower than in 2007.

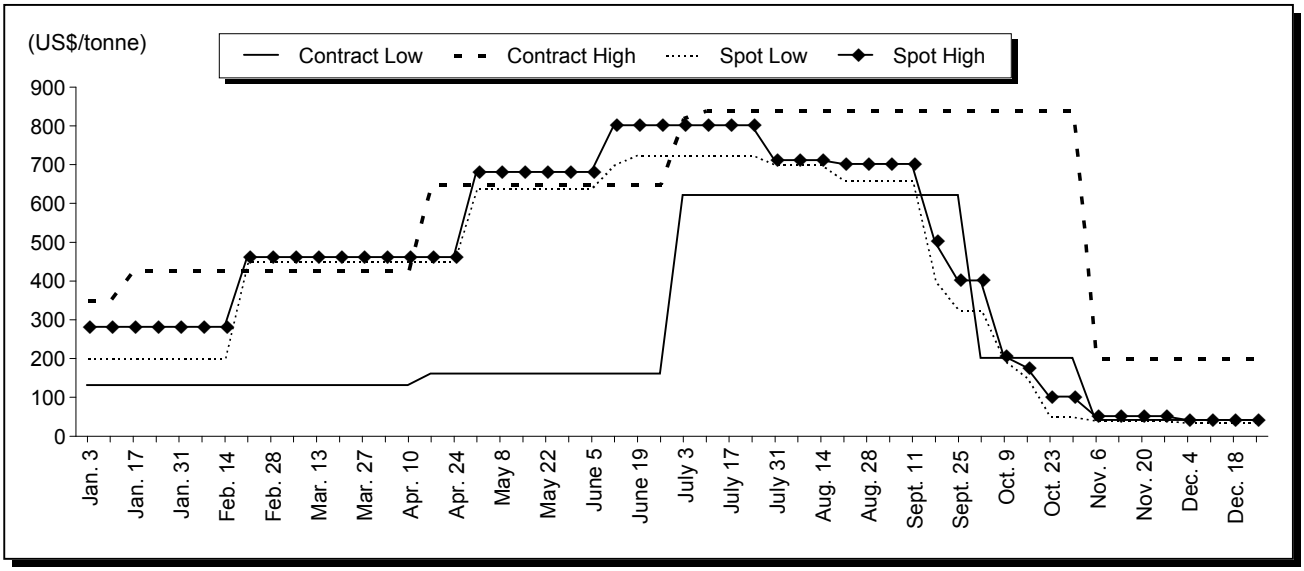
China, the newly emerged, largest SAF producer, produced 11.7 Mt of sulphur and sulphur equivalent in 2008. More than 51% of China's sulphur came from pyrite with 6 Mt of sulphur equivalent produced. The second source of China's sulphur production was sulphur in other forms (SOF), such as sulphuric acid recovered from smelting metals; China produced 4.5 Mt of sulphur equivalent in SOF. The remaining 1.2 Mt was elemental sulphur recovered from oil refineries and natural gas processing.

OUTLOOK

Global SAF supply is forecast to grow significantly in the next five years to reach 91.5 Mt in 2012, an increase of 16.5 Mt from 75 Mt in 2008. The supply growth is mainly

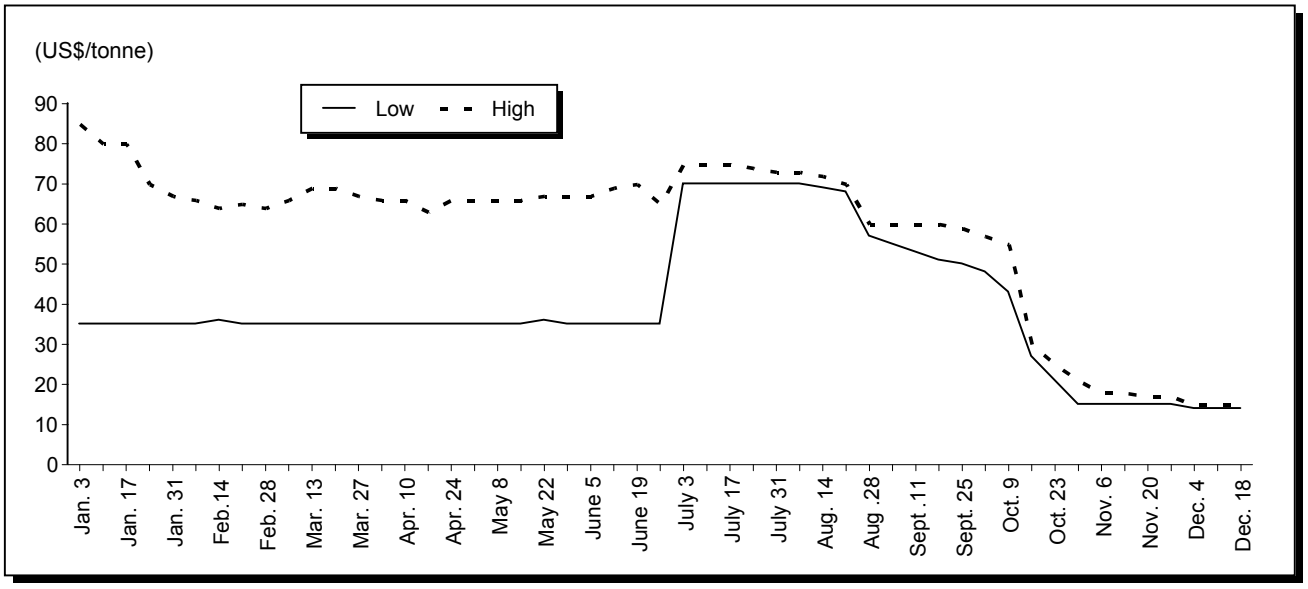
[1] One tonne of sulphuric acid (H_2SO_4) contains approximately 33% sulphur.

Figure 1
Sulphur Contract Price, f.o.b. Vancouver, 2008



Source: FERTECON Limited.

Figure 2
Ocean Freight Rates for Sulphur, 50 000- to 60 000-t Ship, Vancouver to China, 2008



Source: FERTECON Limited.

due to increasing energy production and the drive to achieve cleaner fuels. The largest growth will be in the production of elemental sulphur, which is forecast to increase at 6.4%/y over the next five years (2008-12). Global elemental sulphur production is expected to increase from 50 Mt in 2008 to 65 Mt in 2012. The largest production increase is expected from the Middle East, where output is expected to reach 12.1 Mt in 2012, compared to 8.7 Mt in 2008. The second largest increase is expected from Asian countries, where output is expected to reach 13.3 Mt in 2012 from 7 Mt in 2008, or an increase of 6.3 Mt in volume. North American sulphur production is expected to increase to 18.7 Mt over the next five years. While most increases will come from oil sands production in Canada, refineries in the United States will also contribute. A 2.1-Mt increase in sulphur production is also expected from the former Soviet Union; its volume is expected to increase to 10.6 Mt in 2012 from 8.8 Mt in 2008.

Demand for SAF is expected to reach 87.2 Mt in 2012; however, demand growth is forecast to fall behind supply growth. Elemental sulphur is expected to experience the largest increase in demand to 60.7 Mt in 2012 from 50 Mt in 2008. Demand for elemental sulphur is derived from the demand for sulphuric acid (H_2SO_4). About 90% of elemental sulphur is used in the form of sulphuric acid and the remaining 10% is used in solid form. Half of the sulphuric acid is used in making agricultural fertilizer and the other half is used as industrial chemical ingredients. Global demand for sulphuric acid is forecast to increase to 243 Mt of H_2SO_4 in 2012 from 210 Mt in 2008. Demand for fertilizer uses will increase to 126 Mt of H_2SO_4 by 2012 while demand for industrial uses will increase to 117 Mt over the same period.

Excess sulphur output will likely find no demand and no markets. The supply surplus conditions are expected to continue in even larger volumes given the actions to control sulphur releases to the environment. The global sulphur industry has to explore alternative ways to use, store, or dispose of sulphur.

Canada's sulphur production is expected to remain stable for the medium term and may increase over the long term thanks to the fast-growing oil sands industry. Sulphur recovered from natural gas production is expected to decline as natural gas reserves decrease. However, sulphur recovered from oil sands production is expected to offset the production loss from natural gas. As a consequence of the anticipated oversupply of sulphur, Canadian exports will likely stagnate over the next five years.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 58. (2) Information in this review was current as of March 31, 2009. (3) This and other reviews, including previous editions, are available on the Internet at www.nrcan-rncan.gc.ca/mms-smm/busi-indu/cmy-amc/com-eng.htm.

NOTE TO READERS

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TARIFFS

Item No.	Description	Canada			United States	EU	Japan
		MFN	GPT	USA	Canada	Conventional Rate (1)	WTO (2)
2503.00	Sulphur of all kinds, other than sublimed sulphur, precipitated sulphur and colloidal sulphur	Free	Free	Free	Free	Free-1.7%	Free
2802.00	Sulphur, sublimed or precipitated; colloidal sulphur	Free	Free	Free	Free	4.6%	Free
2807.00	Sulphuric acid; oleum	Free	Free	Free	Free	3%	2.5%

Sources: Canadian *Customs Tariff*, effective January 2009, Canada Border Services Agency; *Harmonized Tariff Schedule of the United States*, 2009; *Official Journal of the European Union* (Tariff Information), September 19, 2008 edition; *Customs Tariff Schedules of Japan, 2009*.
(1) The customs duties applicable to imported goods originating in countries that are Contracting Parties to the General Agreement on Tariffs and Trade or with which the European Community has concluded agreements containing the most-favoured-nation tariff clause shall be the conventional duties shown in column 3 of the Schedule of Duties.
(2) WTO rate is shown; lower tariff rates may apply circumstantially.

TABLE 1. CANADA, SULPHUR SHIPMENTS AND PRODUCTION, 2006-08

	2006		2007		2008 (p)	
	(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
SHIPMENTS (1)						
Sulphur in smelter gases (2)	1 083 554	54 977	1 064 594	47 967	1 057 160	289 722
Elemental sulphur (3)	8 354 366	140 787	8 043 233	242 937	9 188 544	2 754 599
Total sulphur content (2)	9 437 920	195 763	9 107 827	290 904	10 245 704	2 044 321
PRODUCTION						
Sulphur in smelter gases (2)	1 176 429	..	1 167 118	..	1 139 223	..
Elemental sulphur (3)	7 905 870	..	7 621 863	..	8 139 177	..
Total sulphur content (2)	9 082 299	..	8 788 981	..	9 278 400	..

Sources: Natural Resources Canada; Statistics Canada.

.. Not available; (p) Preliminary.

(1) Data compiled regardless of origin (i.e., domestic and foreign source materials). (2) Sulphur in liquefied SO_2 and H_2SO_4 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, oil sands, and 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, 1999-2008

	Production			Shipments (1)		
	Elemental Sulphur	In Smelter Gases	Total Production	Elemental Sulphur	In Smelter Gases	Total Shipments
	(000 tonnes)					
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	7 816	1 109	8 925	6 673	1 078	7 751
2003	8 036	992	9 028	7 988	909	8 897
2004	7 996	1 105	9 101	7 740	1 007	8 747
2005	7 915	1 058	8 973	7 864	1 001	8 865
2006	7 906	1 176	9 082	8 354	1 084	9 438
2007	7 622	1 167	8 789	8 043	1 065	9 108
2008 (p)	8 139	1 139	9 278	9 189	1 057	10 246

Source: Natural Resources Canada.

(p) Preliminary.

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

TABLE 3. CANADA, SULPHURIC ACID PRODUCTION, TRADE AND APPARENT CONSUMPTION, 1998-2007

	Production (3)	Imports (1)	Exports (3)	Apparent Consumption (2)
		(tonnes, 100% acid)		
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	158 148	2 125 740	2 473 220
2001	4 056 948	162 636	1 872 643	2 346 941
2002	4 423 865	128 105	1 970 566	2 581 404
2003	4 065 821	170 173	1 765 770	2 470 224
2004	4 706 462	97 933	2 095 901	2 708 494
2005	4 209 008	92 086	1 910 408	2 390 686
2006	4 275 514	77 348	2 116 776	2 236 086
2007	4 328 460	101 955	2 101 999	2 328 416

Source: Natural Resources Canada, compiled from the reports of producing companies.
(1) Imports and exports include HS code 2807.00. (2) Production plus imports, less exports.
(3) Source of data is Natural Resources Canada's annual survey of Sulphuric Acid Used By End Use.

TABLE 4. CANADA, SULPHURIC ACID, REPORTED CONSUMPTION BY END USE, 2004-07

Reported Use	2004 (a)	2005 (a)	2006 (a)	2007 (a)
		(tonnes)		
Agricultural chemicals and fertilizers	1 200 056	1 101 641	895 363	1 050 212
Pulp and paper	526 884	504 240	497 221	480 305
Industrial inorganic chemicals	446 779	420 935	360 262	345 553
Nonferrous smelting and refining	206 622	79 357	75 350	152 565
Uranium mines	x	x	x	x
Crude and refined petroleum products	19 453	14 456	22 425	x
Other mines, metal and nonmetal	39 903	x	x	33 383
Soap and cleaning compounds	x	x	x	x
Metal rolling and extruding	x	15 394	9 444	x
Electrical products	x	2 831	x	x
Food, brewery and distillery	x	x	x	x
Plastics and synthetic resins	x	x	x	–
Leather and textile	–	x	x	–
Other end uses	103 872	147 633	164 927	176 652
Total (1)	2 617 976	2 402 526	2 139 778	2 383 287

Source: Natural Resources Canada, compiled from the reports of producing companies.
– Nil; x Confidential.
(a) Confidential numbers are included in the total.
(1) Reported consumption does not include imported sulphuric acid.
Note: Numbers may not add to totals due to rounding.