Government of Canada / Gouvernement du Canada

Canada

Natural Resources Canada





# ARCHIVED - Sulphur



## Canadian Minerals Yearbook (CMY) - 2009

***Kevin Stone***

*The author is with the Minerals and Metals Sector,*
*Natural Resources Canada.*
*Telephone: 613-992-5199*
*E-mail: kevin.stone@nrcan-rncan.gc.ca*

## 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 the expanded oil sands production.
- Global production of elemental sulphur is projected to grow at an average rate of 8% per year from 2010 to 2014 and the volume will increase from 48 Mt to 67 Mt. Consumption is forecast to increase at an average rate of 7% per year for the same period and the volume will increase from 47 Mt to 62 Mt. It is forecast that there will be a supply surplus.
- The spot price of elemental sulphur was relatively stable in the first half of 2009 at around US$40/t. It dropped to below US$30/t in August and September, and bounced back to just below US$40/t for the remainder of the year.

## 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. It 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 source of supply.

The principal use of sulphur in the world is as a process agent in the manufacturing of fertilizers such as superphosphates, ammonium phosphate, and ammonium sulphate. The fertilizer industry uses more than half of the world's sulphur production, converting most of it into sulphuric acid to produce fertilizers. The second-largest consuming sector is the chemical industry, where sulphuric acid is used 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 a non-acid form. Sulphur is directly used as a 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 data show Canadian sulphur production was roughly 7.5 Mt in 2009, an 8.4% decline compared to 8.2 Mt in 2008. The decline came mainly from natural gas processing. Canadian elemental sulphur output in 2009 was 6.6 Mt, a 6.2% decrease compared to 7 Mt in 2008. An additional 890 000 t of sulphur equivalent,[1] in the form of sulphuric acid and liquefied sulphur dioxide was recovered from the smelting of metals.

Canada exported approximately 5.8 Mt of sulphur in 2009, a drop of 1.8 Mt, or 23%, compared to 7.6 Mt in 2008. Elemental sulphur exports decreased by 1.3 Mt, or 19%, compared to the previous year's volume. Exports of sulphur in other forms (SOF) were approximately 283 000 t of sulphur equivalent, a decrease of almost 500 000 t compared to 782 000 t in 2008. Elemental sulphur exports to offshore markets were 4.1 Mt in 2009, a decline of 12%, or 550 000 t, compared to 2008's 4.7 Mt. Elemental sulphur exports to the United States dropped by 33% and sulphuric acid exports plunged by 65%.

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 metal smelting.

Elemental sulphur is mainly recovered from natural gas processing in Alberta and a portion is also recovered from gas processing in British Columbia. Although natural gas remained the main source of elemental sulphur production, it is expected to decline in the coming years as known gas reserves are exhausted. 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 ($H_2SO_4$), amounted to 890 000 t of sulphur equivalent, a 22% decline from the previous year's 1.1 Mt of sulphur equivalent. In the past, more than half of the sulphur recovered from smelters in Canada was sold to the United States. The remainder was consumed domestically in the production of fertilizer, pulp and paper, industrial chemicals, and other minor applications. However, U.S. demand for sulphuric acid collapsed in 2009, which forced two smelters in eastern Canada to curtail their production in March and resulted in one smelter shut-down in June and July.

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 12.3 Mt at the end of 2009. 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 the shipment of sulphur out of Alberta's oil sands processing sites.

Oil sands are 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 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 1.6 Mt of elemental sulphur were recovered from processing mined oil sands in 2009, an increase of 16% compared to the 1.4 Mt of output in 2008. It is expected that sulphur recovery from oil sands production will increase, probably reaching about 3 Mt/y by 2015 and 4 Mt/y by 2020.

Canada produced 4.3 Mt of sulphuric acid ($H_2SO_4$) in 2008. Production from metal smelters totaled 3.3 Mt of $H_2SO_4$ and production from burning elemental sulphur amounted to 1 Mt of $H_2SO_4$. Sulphuric acid production in 2009 was estimated at about 3.6 Mt of $H_2SO_4$, of which about 2.6 Mt came from metal smelters and 1 Mt came from the burning of elemental sulphur.

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

## PRICES

The contract export price (Vancouver) for sulphur fluctuated between US$40/t and a high of US$200/t in the first quarter of 2009. The spot price fluctuated in a very narrow range between US$35/t and US$40/t during the same period. The average contract price was US$45/t in the second quarter while the average spot price was US$42.50/t. The third quarter saw both a lower average contract price (US$32/t) and a lower spot price (below US$32/t). In the final quarter of 2009, the average contract price increased to US$45/t. The spot price increased during the same period, hitting a high of US$60/t.

## OUTLOOK

About 80 countries around the world produce sulphur in all forms (SAF). In 2009, total global production of SAF was estimated at approximately 75 Mt, a slight increase from 2008's 74.8 Mt. The lack of real growth was due to the global economic crisis and reduced demand for energy. However, sulphur supply is expected to increase in 2010 as many countries are starting to recover. It is expected that the global supply of SAF will increase to around 81 Mt, or by 8%, in 2010 from the previous year. Elemental sulphur output is expected to increase by 3 Mt to 51 Mt in 2010 while global sulphuric acid supply is projected to reach 201 Mt of $H_2SO_4$.

In the medium term, supply is projected to continue to increase due to expanded oil, gas, and oil sands production. However, the growth rate may not be as fast as previously forecast as some major energy projects have been postponed as a result of the global economic and financial crisis.

The forecast for SAF supply is that it will reach about 97 Mt by 2014. The supply growth will mainly come from elemental sulphur production, which is forecast to increase at an average annual rate of 8% to 67.2 Mt by 2014. The largest increase is expected in Asia, where output should reach 13.4 Mt by 2014, up from 7.6 Mt in 2009. The second largest increase is projected to occur in the Middle East, where output is expected to reach 13.4 Mt by 2014, up from 8.7 Mt in 2009. The third largest increase will come from countries of the former Soviet Union, mostly Russia and Kazakhstan. Sulphur output from this region is forecast to reach 12.6 Mt by 2014, up from 8.8 Mt in 2009. North American sulphur production is expected to increase to 17.5 Mt over the next five years. While most of the increase will come from oil sands production in Canada, refineries in the United States will also contribute to it.

Demand for sulphur is forecast to fall behind supply. The forecast for SAF demand by 2014 is about 87 Mt. Elemental sulphur is expected to increase at an average annual rate of 7% to 62.2 Mt by 2014, up from 47 Mt in 2009. Demand for elemental sulphur is derived from the demand for sulphuric acid ($H_2SO_4$). About 90% of elemental sulphur is converted into sulphuric acid and about 10% is used in a solid form. More than half of the sulphuric acid produced is used to make agricultural fertilizer while the remainder is used as an industrial chemical ingredient. Global demand for sulphuric acid is projected to reach 200 Mt in 2010 and will increase to about 240 Mt of $H_2SO_4$ by 2014. Demand for sulphuric acid for fertilizer use is projected at 110 Mt of $H_2SO_4$, and sulphuric acid for non-fertilizer use should reach 90 Mt of $H_2SO_4$ in 2010; it is forecast to increase to 130 Mt and 110 Mt of $H_2SO_4$, respectively, by 2014.

Excess sulphur output will likely find no demand and no markets. This supply surplus is expected to continue, and will increase as further actions are initiated to control sulphur releases to the environment. Industry has to explore alternative ways to use, store, or dispose of sulphur.

Canada's sulphur production is expected to remain stable over the medium term and may increase over the long term as a result of expanded oil sands production. 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 sulphur exports will likely stagnate over the next five years.

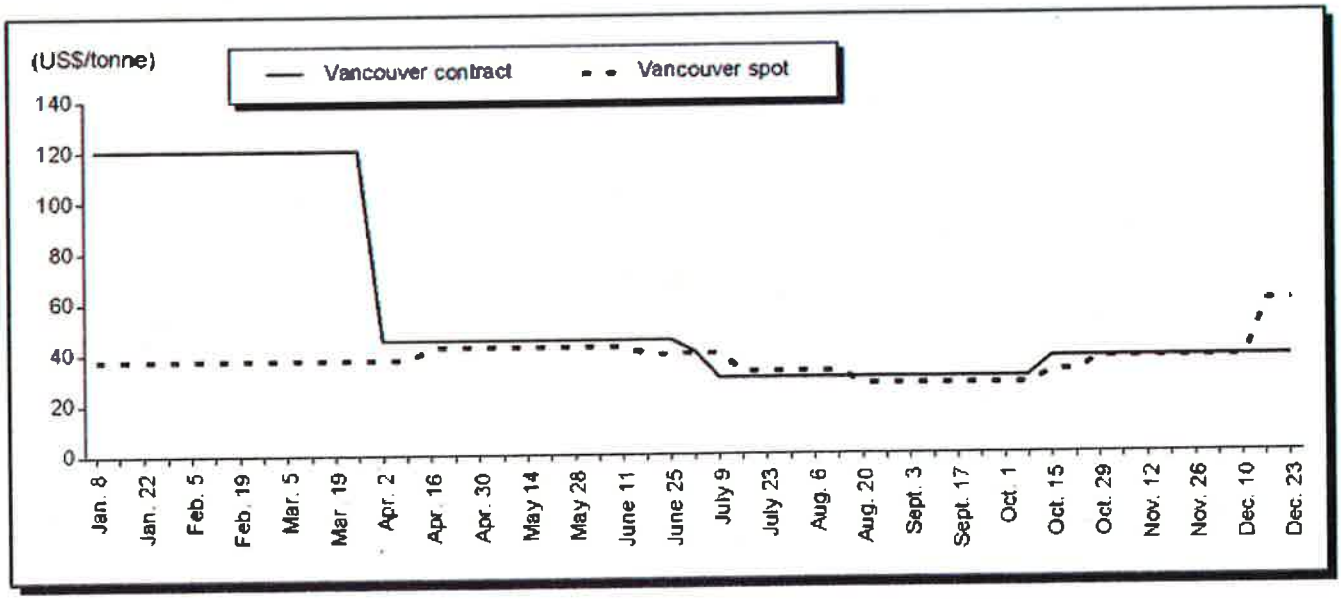
[1] One tonne of sulphuric acid ($H_2SO_4$) contains approximately 33% sulphur.

*Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to the chapter entitled "Definitions and Valuation: Mineral Production, Shipments, and Trade." (2) Information in this review was current as of March 31, 2010. (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

**The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.**

**Figure 1**
**Sulphur Prices, f.o.b. Vancouver, Mean, 2009**




Source: FERTECON Limited.

TARIFFS

| Item No. | Description | Canada | | | United States | EU | Japan |
|---|---|---|---|---|---|---|---|
| | | MFN | GPT | USA | Canada | Conventional Rate (1) | WTO (2) |
| 25.03 | Sulphur of all kinds, other than sublimed sulphur, precipitated sulphur and colloidal sulphur | Free | Free | Free | Free | Free-1.7% | Free |
| 28.02 | Sulphur, sublimed or precipitated; colloidal sulphur | Free | Free | Free | Free | 4.6% | Free |
| 28.07 | Sulphuric acid; oleum | Free | Free | Free | Free | 3% | 2.5% |

Sources: Canadian *Customs Tariff*, effective January 2010, Canada Border Services Agency; *Harmonized Tariff Schedule of the United States*, 2010; *Official Journal of the European Union* (Tariff Information), October 31, 2009 edition; *Customs Tariff Schedules of Japan, 2010.*
GPT General Preferential Tariff; MFN Most Favoured Nation; WTO World Trade Organization.
(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, 2007-09

| | 2007 | | 2008 | | 2009 (p) | |
|---|---|---|---|---|---|---|
| | (tonnes) | ($000) | (tonnes) | ($000) | (tonnes) | ($000) |
| **SHIPMENTS (1)** | | | | | | |
| Sulphur in smelter gases (2) | 1 064 594 | 47 967 | 1 052 332 | 209 421 | 784 600 | 116 168 |
| Elemental sulphur (3) | 8 043 233 | 242 937 | 7 416 964 | 2 165 552 | 5 916 914 | 26 264 |
| **Total sulphur content (2)** | **9 107 827** | **290 904** | **8 469 296** | **2 374 973** | **6 701 514** | **142 432** |
| **PRODUCTION** | | | | | | |
| Sulphur in smelter gases (2) | 1 167 118 | .. | 1 147 732 | .. | 890 170 | .. |
| Elemental sulphur (3) | 7 621 863 | .. | 7 007 706 | .. | 6 577 019 | .. |
| **Total sulphur content (2)** | **8 788 981** | .. | **8 155 438** | .. | **7 467 189** | .. |

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, 1999-2009

| | 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 | 7 008 | 1 148 | 8 155 | 7 417 | 1 052 | 8 469 |
| 2009 (p) | 6 577 | 890 | 7 467 | 5 917 | 785 | 6 702 |

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

| Year | 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.

Date Modified: 2013-05-15