Canadian Perspective on SF_6 Management from Magnesium Industry

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Abstract

Canada is currently the third largest producer of primary magnesium. When a new production facility becomes fully operational, Canada will become the second largest producer. The significance of the sector in the context of greenhouse gas (GHG) emissions as well as other emissions has led to a number of joint initiatives by the government, magnesium producers, and other stakeholders. It is expected that the Canadian initiatives will contribute to meeting the Kyoto challenge. These include measures to substitute SF_6, training, and public education.

Description of Sector

There are two primary smelters located in Becancour, Quebec (Norsk Hydro), and Asbestos, Quebec (Magnola), and one facility in Haley Station, Ontario (Timminco Limited), producing primary magnesium. There are also a number of secondary facilities located primarily in Ontario and Quebec that transform magnesium into castings for a number of industrial applications. Figure 1 shows the locations of these facilities.

Production

Canadian production has increased significantly due to an increase in capacity by Norsk Hydro and new capacity by Noranda. Figure 2 shows the production capacity and trend for the period 1990 - 2005.

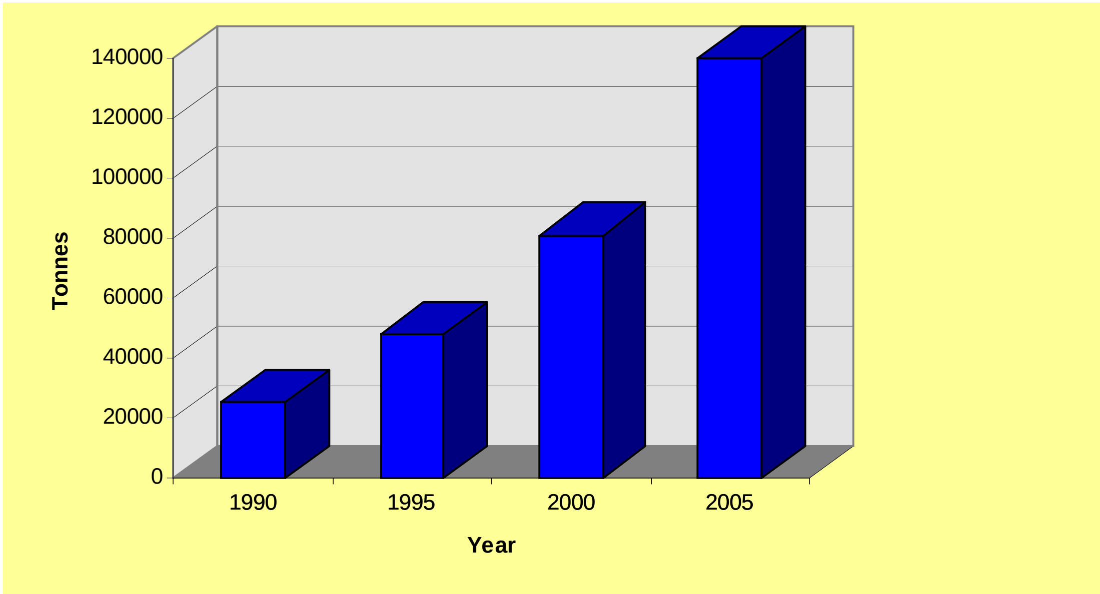
Figure 1: Locations of Magnesium Plants in Canada

Primary Smelters
1. Timminco, Haley Station, Ontario
2. Norsk Hydro, Becancour, Quebec
3. Magnola, Asbestos, Quebec

Partial List of Processors

4. Magnesium Products Ltd., Strathroy, Ontario
5. Indalloy, Rexdale, Ontario
6. Trimag, Haley Station, Ontario
7. Dynacast, Pointe Claire, Quebec
8. ITM, Quebec City, Quebec

Figure 2: Production Capacity and Trend (1990 - 2005)



Source: Canadian Minerals Yearbook: Review and Outlook, Natural Resources Canada, 1998.

Technologies Used in Canada

Two technologies are currently employed in Canada. Norsk Hydro produces magnesium by electrolysis of molten magnesium chloride. Magnesium carbonate is first converted to magnesium chloride. It is then dehydrated and electrolysed to produce magnesium metal. Timminco produces magnesium using a pyroprocessing technique (Pidgeon process). Dolomite (magnesium/calcium carbonate) is crushed, calcined, and reduced by ferrosilicon in a vacuum retort. Magnesium is condensed from the vapour phase producing high purity metal.

The technology used by Noranda involves production of magnesium from asbestos tailings using a proprietary electrolytic process.

Energy Use

Energy consumption for the two processes is different. Typically it takes between 17 to 20 kilowatt-hours/kg of magnesium produced for the pyroprocess while the electrolysis process is stated to use between 12 and 14 kilowatt-hours/kg of magnesium produced.

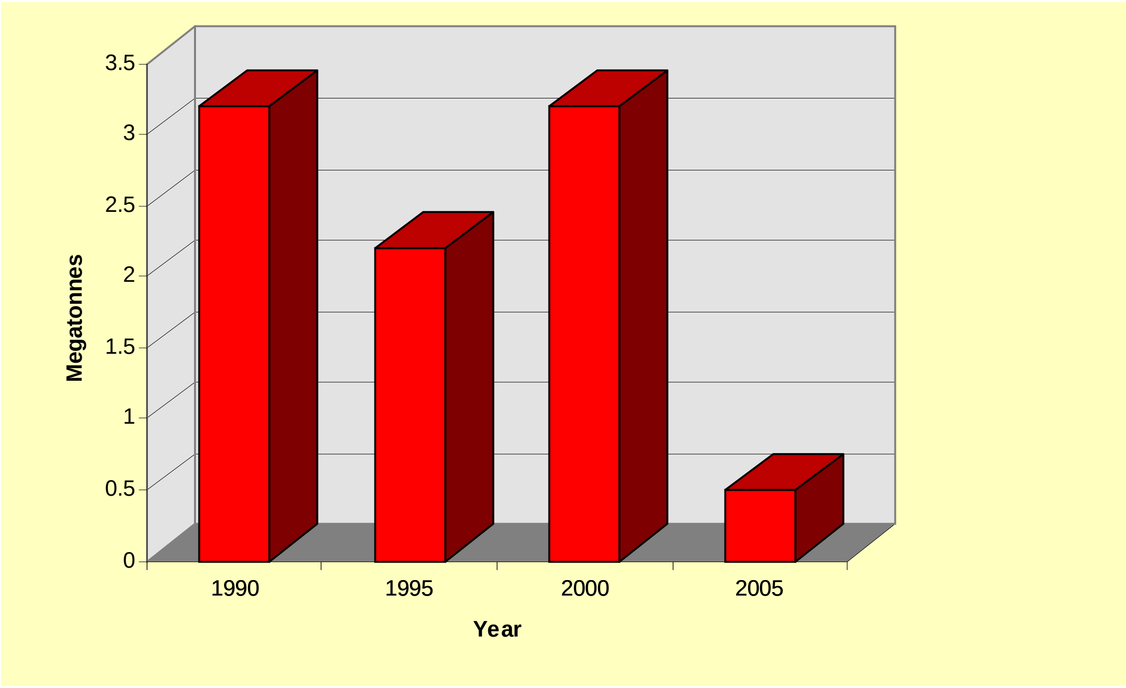
Greenhouse Gas (GHG) Emissions - Sulphur Hexafluoride (SF_6)

All facilities currently use SF_6 as cover gas. This is to prevent oxidation and combustion of exposed magnesium surfaces. It is estimated that 95% of GHG emissions are due to SF_6 use. The remaining 5% comes from fuel combustion and calcination of ores. This gas has been in use for over 20 years by smelters, foundries, and die casters. Usage varies from facility to facility.

Non-Energy GHG Emissions - Carbon Dioxide (CO_2) Equivalent

Carbon dioxide is produced during the conversion of magnesite and dolomite. In the Pidgeon process, the relative emission of CO_2 is higher because dolomite used in the process contains a mixture of $MgCO_3$ and $CaCO_3$ and thus releases more CO_2 per tonne of magnesium because $CaCO_3$ is also decomposed to form CaO and CO_2. The electrolytic process uses magnesite, which is primarily $MgCO_3$ and therefore releases less CO_2 per tonne of magnesium produced. Figure 3 shows the non-energy GHG emissions for the period 1990 - 2005, expressed as CO_2 equivalent.

Figure 3: Non-Energy GHG Emissions Trend, 1990 - 2005 (CO_2 equivalent)



Source: Magnesium Industry Options Paper, *Report of the Minerals and Metals Working Group of the Industry Issue Table to The National Climate Change Secretariat,* October 1999.

The trend shown above assumes that alternatives to the use of SF_6 will be implemented at all facilities by year 2005. There is commitment by two large producers to eliminate the use of SF_6 by 2005. Therefore, barring unforeseen circumstances, it is most likely that the forecast will be achieved by 2005, thus exceeding several fold the 6% reduction from 1990 levels.

Status of Technology Development to Reduce SF_6 Emissions

A literature survey and preliminary contacts show that efforts are currently being directed to finding a suitable technology and product to substitute for the use of SF_6.

GHG Reductions

There have been considerable reductions during the period 1990 – 1995, as seen from Figure 3. The increase shown for 2000 is due to the startup of Magnola, Inc. The reductions were achieved by reducing the quantity of SF_6 used. Most facilities are expected to use substitutes by 2010. A number of companies have committed to replace SF_6 by 2005.

Current Initiatives

One facility has reported that it has eliminated the use of SF_6 by converting to a sulphur dioxide (SO_2) gas system. Another smelter and a die-casting plant started SO_2 system tests and are expected to phase out SF_6 within the next year. Two primary smelters have made voluntary agreements with the respective provincial environment ministry to eliminate the use of SF_6. Another smelter is conducting research on cover gas alternatives. Other producers are believed to be seeking alternatives.

Initial work has started on a research project involving the International Magnesium Association and Canadian companies to replace SF_6. The Canadian government has been asked for assistance and is looking at this carefully. There is also work being done by Hatch associates to replace SF_6 with boron trifluoride (BF_3).

It is noted that once SF_6 is replaced by alternatives, further reductions can be achieved by other measures. GHG emissions resulting from fossil fuel use and calcination of ores are not likely to be further reduced from existing facilities. However, it is also important to note that hydro-electricity is the principal energy source used in Canada and has thus a lower GHG intensity per tonne of magnesium produced in comparison with producers in other countries that use thermal power.

Table 1: A Proposed Action Plan (2001 - 2004) - Summary

Year	Action	Task
2001-02	Preliminary Actions	Initiate SF_6 data collection from casters.
	Preliminary Actions	Analyze CO_2 and indirect emissions to clarify GHG estimates.
	Preliminary Actions	Assess current worldwide research into SF_6 alternatives.
	Preliminary Actions	Assess current status & intentions of magnesium companies.
	Voluntary Agreements	Set up national voluntary agreement to eliminate SF_6.
	Voluntary Agreements	Organize monitoring and reporting system for sector.
2002-03	Voluntary Agreements	Continue enhancement of existing voluntary agreements.
	Additional Studies	Support technical programs or studies for companies with significant SO_2 barriers.
	Research	Assist in research & development of SF_6 alternative systems.
2003-4	Voluntary Agreements	Monitor and continue to develop voluntary agreements.
	Financial Measures	Monitor progress of technology adoption. Study possible financial incentive measures to accelerate adoption if necessary.

Source: Adapted from Minerals and Metals Climate Change Strategy Paper, Final Report, August 2000.

Web Sites

- Canada's National Climate Change Process: www.nccp.ca
- Environment Canada: www.ec.gc.ca
- Natural Resources Canada: www.NRCan-RNCan.gc.ca
- Voluntary Challenge and Registry, Inc.: www.vcr-mvr.ca