TENTH ANNUAL REPORT TO EPA

CHLOR-ALKALI INDUSTRY
MERCURY USE AND EMISSIONS
IN THE UNITED STATES
For the Year 2006

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INTRODUCTION and SUMMARY

The Chlorine Institute, Inc. ("Institute" or "CI") continues to be a proactive leader in the effort to reduce mercury use and emissions in the United States. This Tenth Annual Report to the U. S. Environmental Protection Agency ("EPA") illustrates the chlor-alkali industry's continuing progress in voluntarily reducing mercury use and emissions.

In 1996, the Chlorine Institute volunteered to reduce mercury use by 50 percent over the base years of 1990 through 1995. Since then the Institute and its members have worked cooperatively with federal and state authorities to meet and exceed that goal. Since 1995, an eleven-year period, total annual mercury used by the chlor-alkali industry has been reduced by over 92%.

CI's member companies that use mercury cell technology to manufacture chlorine are safe and perform above and beyond all applicable laws and regulations pertaining to mercury use and emissions. The chlor-alkali industry reaffirms its support for the sound management of mercury by committing to four action steps:

- Continue to account fully for mercury used;
- Further reduce the mercury used;
- Continue to improve methods to more accurately measure emissions from the cell rooms at each mercury cell chlor-alkali facility; and
- Further reduce air emissions by over 90% from facilities by implementing the extensive new work practice standards contained in and fully complying with EPA's new National Emission Standard for Hazardous Air Pollutants: Mercury Emissions from Mercury Cell Chlor-Alkali Plants ("NESHAP").

The remainder of this report will focus on the following:

- Status of chlor-alkali mercury cell facilities in the United States;
- Mercury purchases and use during the calendar year 2006;
- Reductions in mercury emissions to the environment; and
- Key initiatives by companies, the Chlorine Institute and the World Chlorine Council to further the industry's commitment to the safe use of mercury.

MERCURY CELL FACILITIES

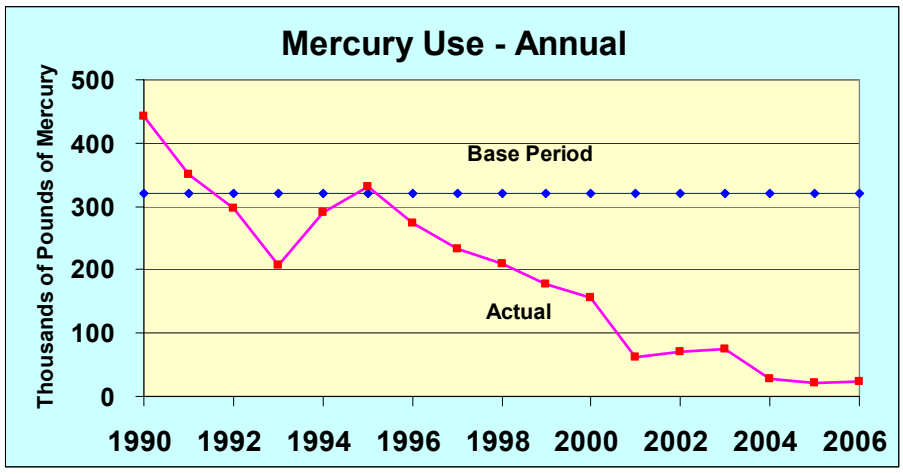
No mercury cell facilities closed in the calendar year 2006. As of the date of this report one facility will complete conversion to the membrane cell process by the end of August 2007. Two additional facilities have announced conversion to membrane technology by the end of 2008 and 2009. A fourth facility intends to close by the end of 2008. These actions will further reduce the chlor-alkali industry's mercury use and emissions. Based on the currently announced plans, only four mercury cell facilities will be in operation in the United States at the end of 2009.

In 1996, when the industry's original commitment to mercury reductions was made, there were 14 operating mercury cell plants. Of the nine facilities that have eliminated or plan to eliminate the use of mercury, three have or will have converted to membrane technology and six have or will have simply closed.

MERCURY USE AND PURCHASES

Using 1990 to 1995 as the baseline, the chlor-alkali industry has reduced its mercury usage by over 92% (see Figure 1 below). Mercury use in 2006 was 24,000 pounds. Mercury use is detailed in Table 1 found in Appendix A.

Figure 1



Chlor-alkali mercury use in the United States per ton of chlorine capacity for 2006 was 0.02 lb/ton chlorine capacity (see Figure 2 below).

Figure 2

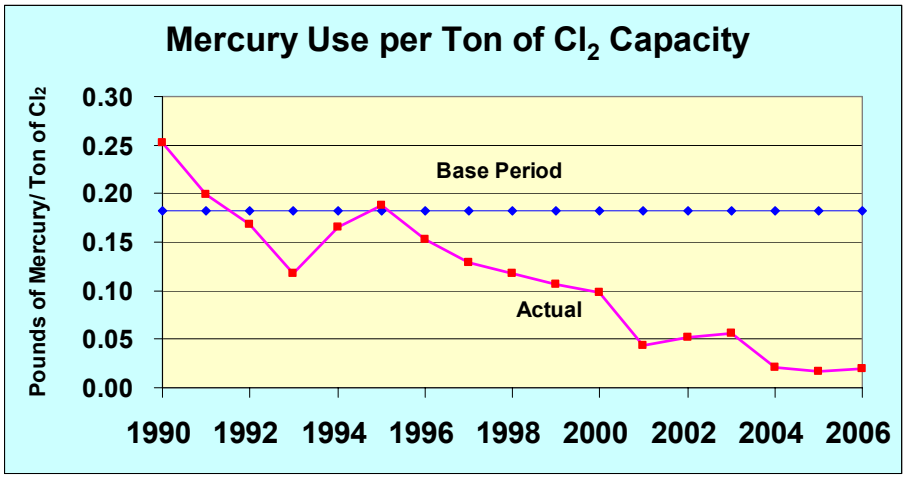
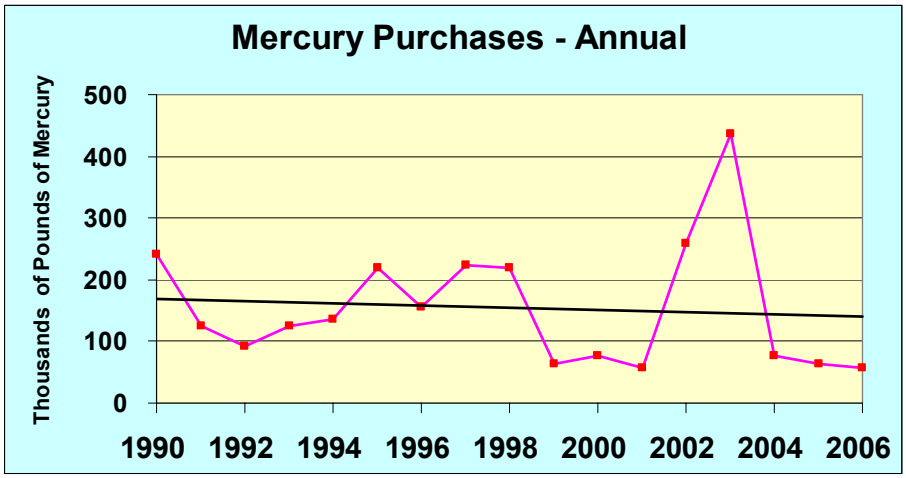


Figure 2 clearly shows that the chlor-alkali industry has significantly reduced its use of mercury, not just because of facility closures, but more importantly because of the more efficient utilization of mercury. This is reflected in an 89% reduction in the 2006 mercury used per ton of chlorine capacity when compared to the 1990 through 1995 baseline.

As is evident from both Figures 1 and 2, reductions in mercury use have slowed. This trend can be attributed to the effectiveness of past reduction efforts.

Mercury purchases in 2006 were 58,000 pounds (see Figure 3 next page). As explained in past reports, mercury purchases do not necessarily equate to mercury use. Process upgrades can necessitate the use of higher volume equipment and longer piping runs require that more mercury be added to the process. More mercury in the process does not equate to greater mercury emissions. In fact, most upgrades typically instituted as part of programs to upgrade cell room technology and improve system performance, also minimize mercury releases. Installation of new and better designed equipment minimizes fugitive emissions. Other upgrades allow the facilities to operate longer between cell maintenance. Less frequent cell maintenance means fewer openings of the cell and thus a reduction in mercury emissions. Annual mercury purchases rise or fall depending on the quantity of upgrades.

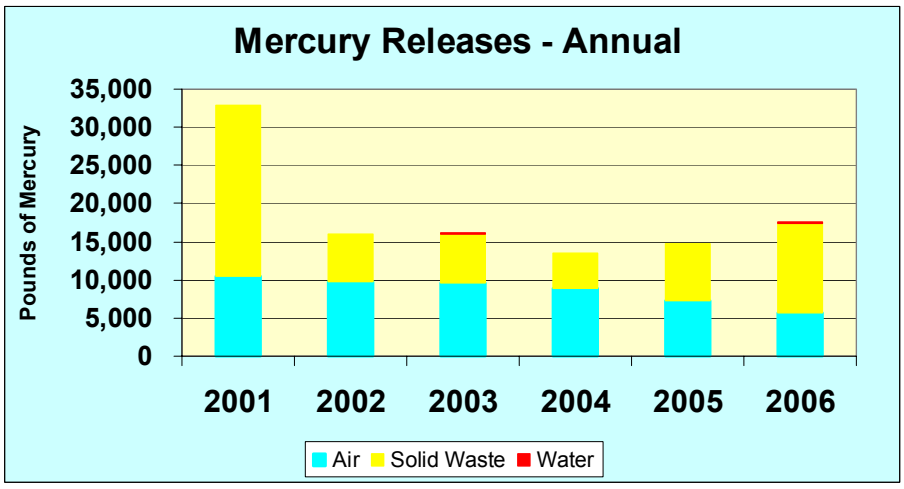
Figure 3



MERCURY RELEASES TO THE ENVIRONMENT

Mercury releases to the environment from the chlor-alkali industry were approximately 17,500 pounds (see Figure 4 below). Mercury emissions are detailed in Table 2 found in Appendix A. This latest information shows a 47% reduction in the chlor-alkali industry mercury emissions[1] since 2001. These emissions are a very small portion (approximately 8%) of the total mercury releases occurring in the United States[2] and have fallen at a greater rate than the overall decline.

Figure 4



[1] Mercury releases to water are not easily depicted in Figure 4 since these quantities are less than 0.1% of the total.
[2] 2002 U.S. mercury releases estimated at 111.4 tons (GLBTS 2006 Progress Report, February 2007).

KEY PROJECTS – NEW AND CONTINUING

Facility Specific Projects in 2006

Below is a summary of key projects completed and/or started at mercury cell facilities during the 2006 calendar year. These projects resulted in reduced mercury emissions but may have also resulted in a short term increase in mercury purchases since sometimes these projects require an increase in mercury process inventories. Process modifications resulted in an increase of process mercury inventory by 20 tons. Most of this mercury was added as virgin mercury obtained from existing corporate stockpiles or from purchases. Approximately 10% came from in-process recovery[3].

The following process modifications occurred in 2006:

- Plant A converted to larger decomposers which required the addition of mercury (approximately 37,000 pounds) into the process inventory;

- Plant B enlarged some decomposers resulting in the addition of 1,990 lbs of mercury to the process inventory; and

- Plant C added 1,900 pounds of mercury. The increase in mercury inventory was necessary when the volume of mercury residing in the cells was increased as part of an upgrade to raise the cell chlorine production efficiency. This also required the installation of larger impellers in the mercury pumps.

These process changes allow for reductions of mercury emissions in two ways. First, because much of the newer equipment being installed is larger than the previously installed equipment, operating cycles between maintenance activities are lengthened. Maintenance activities nearly always require equipment openings. Even though many improvements in techniques to reduce mercury emissions during equipment openings have been made, emissions can not be totally eliminated. Therefore, a lower number of openings results in reduced mercury emissions. Secondly, newer equipment is better designed to reduce fugitive emissions. Sealless mercury pumps, sealed end boxes, and improved hydrogen cooler design are examples of equipment changes that result in reduced fugitive emissions.

Industry-Wide Efforts

Besides aggressively pursuing specific facility-based opportunities for mercury use and emissions reductions, the U.S. chlor-alkali industry's voluntary efforts have also focused more broadly both domestically and worldwide. Since issuing its Ninth Annual Report to EPA, the Institute has continued to coordinate the industry's ongoing efforts to reduce mercury use and emissions. Specifically, CI and its member companies have worked on the following projects:

[3] In-process recovery: Mercury can accumulate in filters, tanks, etc. When this mercury is recovered it is placed back in the facility's mercury inventory.

- Mercury NESHAP

The new Mercury NESHAP (40 CFR Part 63) became effective on December 19, 2006. This new regulation replaces the old Part 61 NESHAP rule. The new regulation contains numerical emission limits for the three primary air sources of mercury at mercury cell facilities: 1) end-box ventilation system vents, 2) by-product hydrogen system vents, and 3) mercury thermal recovery unit vents. It also requires that the plants either install continuous mercury emission monitors or test each vent at least once per week.

The rule also contains a set of work practice standards (representing the best practices of the industry) that are considerably more stringent that the fugitive emissions limits or procedures required under the old Part 61 Mercury NESHAP. The new rule contains an alternative program that involves continuous mercury air concentration monitoring and problem correction when a fugitive emission action level is exceeded. All operating mercury cell facilities are in compliance with this new regulation[4].

- Chlorine Institute - 14th Annual Mercury Issues Workshop

Held at the Chlorine Institute's Annual Meeting in Houston, TX on March 18, 2007, session topics included:

  - Overview of Mercury Fugitive Emissions from Chlor-Alkali Facilities
  - Update from the U.S. EPA on the Mercury NESHAP
  - Fugitive Emissions Monitoring – Report on Side-by-Side Testing with EPA
  - Mercury NESHAP Compliance
  - United States Government Activities on Mercury
  - International Activities on Mercury
  - Working with NGOs

The event was well attended and continues to serve as a useful forum for both U.S. and international users of mercury cell technology.

- World Chlorine Council

The World Chlorine Council ("WCC") (www.worldchlorine.com) is a global network of national and regional chlor-alkali associations in over 27 countries and five continents, representing more than 80 percent of global chlorine and caustic-soda production. The WCC voluntarily engages in global programs to reduce mercury use, consumption and emissions from the mercury cell manufacturing process. CI is a WCC managing partner.

It is well understood that mercury in the environment is not entirely attributable to local sources. Mercury released in other parts of the world can be deposited in the United States. Mercury is a

[4] The US EPA has given ERCO Worldwide, Port Edwards, WI a one year deferral on compliance with the Mercury NESHAP to allow the facility to evaluate conversion to a non-mercury technology. The facility is on schedule to be in compliance by Dec 19, 2007.

global pollutant and thus requires globally coordinated solutions. International efforts by CI (through the WCC) to reduce mercury emissions are a critical component of the industry's mercury reduction efforts.

WCC's global programs augment the programs and commitments made by regional WCC organizations. Emissions from this sector will continue to decline as the industry implements best available techniques and transitions to alternative, non-mercury technologies.

As part of these efforts, the WCC has been an active supporter of the United Nations Environmental Program ("UNEP") Global Mercury Program and has made a sustained effort to help mercury cell chlor-alkali producers around the world reduce mercury use and emissions. Furthermore, the WCC agreed to support and contribute to the *UNEP Global Partnership on Mercury Reduction in the Chlor-Alkali Sector*. The Global Mercury Partnership builds upon WCC's long-standing commitment to share best practices globally for reducing the use and release of mercury from mercury-cell chlor-alkali facilities. WCC has strived with governments, chlor-alkali producers, and the UNEP to help make this partnership a success.

Activities have included:

- Promotion & Implementation of Best Practices – WCC continues to encourage the adoption of best management practices to facilitate reductions in mercury releases and use from mercury-cell facilities around the globe. A key mechanism for sharing and implementing these best practices has been in-country workshops designed to allow industry experts and facility managers to share best practices and analyze how these practices could be applied to a specific facility so as to further reduce mercury use and emissions. Where appropriate, these workshops have included follow-up demonstration projects that when implemented are expected to result in tangible reductions in the amount of mercury used and released at specific mercury-cell chlor-alkali manufacturing facilities. To date workshops and technical exchange programs have been held in India, Russia and Mexico.

- Mercury Reporting & Measuring Progress – WCC supports the partnership objective to collect data concerning mercury use and emissions within the chlor-alkali industry. WCC has worked to catalogue, to the best of its knowledge, those facilities utilizing mercury-cell technology. WCC is also working to facilitate the collection on mercury use and emissions from chlor-alkali facilities worldwide. As part of its commitment to the Global Mercury Partnership, WCC submits an annual report to UNEP summarizing regional mercury use, consumption, and emission. The First Annual WCC Report was presented at the 2007 UNEP Governing Council meeting.[5]

[5] The document is available at: http://www.chem.unep.ch/mercury/Sector-Specific-Information/Chlor-alkali_facilities.htm

Update on 2004 Commitments

In its 2004 Annual Report to EPA, The Chlorine Institute discussed two new commitments made to the Binational Toxics Strategy. Specifically, the Chlorine Institute and its members committed to 1) enhancing cell room air monitoring, and 2) fully accounting for the industry's mercury inventory. The following summarizes the status of these commitments:

- Enhancing Cell Room Air Monitoring

Three facilities completed installation of cell room mercury monitoring systems[6] in 2005/early 2006. EPA has completed system evaluation and side-by-side testing for fugitive emissions and/or facility-wide emissions at these three chlor-alkali facilities. This three-part study will assist the Agency as it finalizes issues regarding the Mercury NESHAP.

One study addressed whether the fugitive air emissions from a mercury cell chlor-alkali plant are on the order of magnitude of the historical assumption of 1,300 grams per day (0.5 tons per year) or on the order of magnitude of the unaccounted for mercury. As part of this study, EPA performed two emission test series in 2006. One test series was performed outside and downwind from the plant, and theoretically measured all mercury air emissions from the process, both inside the cell room and outside the plant. The other test series was performed inside the cell room. These test series have been completed and EPA is in the process of evaluating the data. Both test series also will compare the EPA data to the plants' continuous mercury cell room monitoring systems (MMS) that were in place during the EPA tests.

In a second study, EPA performed tests at three facilities to validate continuous MMS and flow measuring systems. Two of the three facility tests were completed in 2005 and one was completed in 2006. Reports for the 2005 tests are currently available to the public on request to EPA. The two 2005 test series showed that the MMS and flow measurements at the facilities were in good agreement with the EPA measurements.

The third study will attempt to determine the process, maintenance, and other operational activities that most significantly impact fugitive mercury air emissions. The EPA will use these data to evaluate whether relationships exist between fugitive mercury air emissions and cell room activities (maintenance and other operational activities), which could be used to develop an emissions factor that could be applied industry-wide.

The final reports should be issued late in 2007.

[6] All of the remaining facilities have also installed systems as necessary to comply with the Mercury NESHAP.

- Fully Accounting for Mercury Inventory

The Chlorine Institute believes it has made outstanding progress in its efforts to fully account for the mercury the chlor-alkali industry uses. Nevertheless, CI continues to refine its data collection and analysis methodology. In 2004, in order to further clarify the facts, CI added a new table, Table 2 (Appendix A), to this report. Table 2 is a compilation of data for the calendar years 2002 through 2006 showing the differences between mercury purchases, mercury use, reported toxics release inventory (TRI) emissions, and mercury contained in chlor-alkali products. The key line item, "unaccounted for mercury", is near the bottom of the table.

The Chlorine Institute stated then that it was not satisfied with the unaccounted for mercury reported in 2002 and 2003 even though this unaccounted inventory represented only one percent of the total mercury inventory for the industry. The industry committed then to fully account for the mercury it uses. In 2005 and 2006 the unaccounted for mercury amounted to three tons; a reduction of nearly 90% from the prior years.

Mercury process inventory is typically measured using the radioactive isotope technique discussed in Chlorine Institute publication, *Guidelines for Conducting a Mercury Balance*, May 1999. The methodology has a variability of between 0.1 and 0.3 percent. Applying this variability to the 2006 year ending mercury inventory of 2,579 tons reveals the data to be accurate to within two to eight tons. The 2006 unaccounted for mercury equaled 2.9 tons or 0.1 percent of the total inventory.

Past Efforts Continue to Provide Environmental Benefits

Since the industry's commitment to mercury reductions, facilities have taken many steps to reduce mercury emissions. These changes have been detailed in prior reports but are summarized below because each historic process improvement continues to pay dividends in the form of mercury emissions reductions in every year that follows. Past activities have included the design, use and installation of:

- Improved collection devices to more effectively capture mercury during cell maintenance activities;

- New decomposer compression system design to improve efficiency of amalgam decomposition;

- New gasket materials to provide better seals on mercury containing equipment;

- Additional collection devices such as weirs to cell room trenches to more effectively recapture and reuse accumulated mercury;

- Process changes to reduce mercury carry-over with the water exiting the end boxes resulting in less mercury handling;

- More efficient electrical current distribution equipment; and
- Larger decomposers, thus lengthening the time between scheduled maintenance (i.e. reducing the need to open the equipment.)

CONCLUSION

The Chlorine Institute believes it has proactively addressed many of the concerns regarding the use and release of mercury into the environment by mercury cell chlor-alkali facilities. In addition, the Institute's commitment to the Binational Toxics Strategy is completed. CI and its members believe this voluntary effort, no matter how it is measured, has been a success. Nevertheless, the Chlorine Institute plans to continue its efforts to reduce mercury use and environmental releases in the chlor-alkali sector both in the United States and internationally through its participation in the WCC and UNEP Global Mercury Program.

ABOUT CI

The Chlorine Institute Inc., founded in 1924, is a non-profit trade association of companies and other entities involved or interested in the safe production, distribution and use of chlorine, sodium and potassium hydroxides, and sodium hypochlorite, and the distribution and use of hydrogen chloride.

Because of chlorine's nature and its widespread and varied applications, the promotion of its safe use and handling has long been an accepted responsibility of its producers, packagers, distributors and users. The Institute is the focal point for their joint efforts.

For more information on CI's mission, go to www.chlorineinstitute.org.

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APPENDIX A
Data Tables

Table 1
Mercury Purchase and Usage[1]
Chlor-Alkali Industry - Mercury Cell Process

	BASELINE (Average 1990 – 95)	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005[2]	2006
otal Mercury Purchases, .	296,408	242,015	320,460	340,658	214,749	172,885	69,932	259,069	437,434	75,982	63,829	57,304
otal Mercury Purchases, ons	148	121	160	170	107	86	35	130	219	38	32	29
otal Mercury Used, .	319,715	273,659	232,056	210,213	177,968	156,403	61,506	71,052	75,309	28,637	20,660	24,210
otal Mercury Used, ons	160	137	116	105	89	79	30	36	38	14	10	12
nnual Chlorine Capacity, ,000 tons	1,758	1,784	1,801	1,785	1,676	1,589	1436	1355	1,353	1,363	1,221	1,206
otal Number of Mercury ells	762	762	762	762	706	682	646	594	594	594	506	506
ercury Used, /ton of Chlorine Capacity	0.182	0.153	0.129	0.118	0.106	0.102	0.044	0.052	0.056	0.021	0.017	0.020

otes:
ton = 2,000 lb
Data was collected from those plants operating at the end of the calendar year.
In 2005, the Occidental Chemical Company plant in Delaware City, DE closed. Beginning in 2005, data for this facility is no longer collected and included in the totals.

Table 2
Mercury Balance and Release[1, 2]
Chlor-Alkali Industry - Mercury Cell Process
(in tons)

		2002	2003	2004[3]	2005	2006
1	Mercury Virgin Inventory as of Jan 1	67	46	166	90	44
2	Mercury Process Inventory as of Jan 1	2,478	2,593	2,654	2,493	2,561
3	Total Mercury Inventory as of Jan 1 [3] = [1] + [2]	2,545	2,639	2,820	2,583	2,605
4	Mercury purchases during calendar year	130	219	38	32	29
5	Total Mercury Available [5] = [3] + [4]	2,675	2,858	2,858	2,615	2,634
6	Mercury Virgin Inventory at on site storage as of Dec 31	46	166	96	45	34
7	Mercury Process Inventory as of Dec 31	2,593	2,654	2,748	2,560	2,579
8	Total Mercury Inventory as of Dec 31 [8] = [6] + [7]	2,639	2,820	2,844	2,605	2,613
9	Mercury Transferred Out[4]	0	0	1	0	9.2
10	Total Mercury Used (Consumed) [10] = [5] – [8] - [9]	36	38	13	10	11.8
11	Mercury Released to the Environment (TRI)	8.2	8.1	6.8	6.7	8.8
12	Mercury Contained in Products	0.2	0.1	0.1	0.1	0.1
13	Total Mercury Losses to Environment and Products	8	8	7	7	8.9
14	Unaccounted for Mercury [14] = [10] – [13]	28	30	6	3	2.9
15	Number of Mercury Cell Facilities Operating at End of Year	9	9	9	8	8

Notes:
[1] For facilities operating at year end in the calendar year.
[2] Numbers may not add due to rounding.
[3] 2004 ending inventory and 2005 beginning inventory data adjusted to reflect shutdown of Delaware facility.
[4] Sent off-site for recovery, not returned during calendar year.