OCEANA | Protecting the World's Oceans
www.oceana.org

JULY 2007

CLEANING UP:

TAKING MERCURY-FREE CHLORINE PRODUCTION TO THE BANK

Simon Mahan
Jacqueline Savitz

EXECUTIVE SUMMARY

> "Chlorine production is currently among the major industrial sources of mercury releases to the environment."

Of the serious environmental challenges posed by the industrial age, few lend themselves to clear, achievable solutions quite the way that mercury pollution in the chlorine industry does. In 1894, the industry discovered the unique qualities of mercury for creating an electrolytic cell to split salt molecules, revolutionizing the production of chlorine around the same time internal combustion engines were first invented. As revolutionary as it may have been, it is not revolutionary anymore. Depending on mercury to make chlorine is like depending on the Model-T for modern commerce. Inefficient, to say the least.

Because of this archaic technology, chlorine production is currently among the major industrial sources of mercury releases to the environment. Two other approaches that do not use mercury have been widely adopted. Yet many companies still rely on this 110-year-old process, even though it creates numerous tons of mercury wastes with associated disposal and cleanup problems, pumps up corporate electric bills unnecessarily, and in some cases turns neighboring communities against the companies. Today in the United States, five mercury-cell chlorine plants continue to rely upon this technology, releasing tons of mercury unnecessarily. We call them the "Filthy Five."

Conversely, more than one hundred facilities just like these five mercury-cell chlorine plants waded through the industrial inertia and converted to better technologies. These plants began putting mercury and its associated challenges behind them as early as 1974. In doing so, they likely saved themselves millions of dollars in costs for fines, upgrades, cleanups, and other expenses that dogged their competitors.

In the seventies, technology using a diaphragm to create the electrolytic cell came into vogue, though it too had been invented in the previous century. Many plants switched to diaphragm-cell technology, while others did not. Around the same time, an even better method using membrane-cell electrolysis was being developed, increasing efficiency and still allowing the production of chlorine and caustic soda without the use or release of mercury. Many facilities soon began to shift to membrane-cell technology, as is shown in this report. In fact, some that had already undergone a shift to diaphragm technology saw the benefits of membranes and shifted a second time. Other facilities, however, sat out even this second revolution, sticking with mercury in spite of its associated costs.

Globally, the chlorine industry had largely moved to mercury-free technology by the turn of the 21st century. In the United States, the industry reported that by 2004, 90 percent of its chlorine was produced using mercury-free technology and no new mercury-cell plant has been built since 1970. Oceana's Campaign to Stop Seafood Contamination targets the plants responsible for the remaining 10 percent.

This report details the successes of companies that have shifted and compares their successes to the lagging facilities in the United States that have remained in the 1894 technological rut. For each plant, Oceana looks at the likely costs of its mercury use and the financial benefits of moving away from mercury. We also tackle some of the prevailing arguments for not shifting – arguments that have been challenged by at least 115 similar facilities around the world. Compiling all of this history in one place clearly shows that the remaining mercury-cell plants are causing a major mercury problem with a clear, achievable solution that should be immediately implemented to benefit the environment and public health.

[KEY FINDINGS]

- If the Filthy Five eliminate mercury use in chlorine production, nearly 4,400 pounds of reported mercury releases would be eliminated every year. This does not include mercury that is "lost" and not monitored at the plants.
- At least 115 plants around the world have shifted or plan to shift to mercury-free technology since 1974. At least thirty-six of those plants shifted to diaphragm technology first and then upgraded to membrane-cell technology a short time later.
- Plants that have shifted to membrane-cell technology generally have achieved increases in energy efficiency between 25 and 37 percent per ton of chlorine produced. Since electricity can make up as much as half of total production costs, increasing efficiency can vastly improve a plant's profitability.
- Assuming a 25 percent increase in energy efficiency, if each of the Filthy Five converted, their total savings from energy efficiency could amount to $98.6 million over five years.
- Improved energy efficiency would also reduce greenhouse gas emissions. If the Filthy Five were to switch to mercury-free membrane-cell technology, the corresponding decrease in energy consumption would save enough electricity to power 40,200 average homes.
- Since membrane cells are smaller than mercury cells, allowing more cells to operate in a given space, many plants choose to increase their capacity when they shift. Increases on the order of 25 percent are common. If just four of the "Filthy Five" plants made such a change, their collective sales would increase by more than $302 million over five years and they would save nearly another $14.6 million due to the increased energy efficiency over five years. Expansion of the largest plant, Olin's Tennessee plant, is not assumed in this estimate.
- There is no need to use mercury to create "mercury-grade," also called "rayon-grade," caustic soda, despite industry arguments. Rayon manufacturing at plants in India clearly shows that membrane-grade caustic can be used effectively. In addition, rayon textiles have not been manufactured in the United States for nearly a decade.
- Many household products made using chlorine or caustic soda contain traces of mercury. These include toothpaste, soap, shampoo, bleach and even soft drinks. When mercury is used to make caustic soda it is often found as a contaminant in the final product, and this may be the source of some of the residues.

Based on these findings, two conclusions become apparent. First, it is clear that shifting to membrane-cell technology is both achievable and affordable, and second, that it is a necessary step to stop mercury releases and protect public health and the environment.

PPG INDUSTRIES

Natrium, West Virginia

PPG owns and operates one of the five remaining chlor-alkali facilities in the United States that continue to report emitting hundreds of pounds of mercury pollution annually without committing to stop using mercury. In 2005, PPG's Natrium, West Virginia plant reported pumping 400 pounds of mercury into the air,[180] nearly twice as much as the average power plant.[181] Readily available mercury-free technology, if installed, could benefit the plant dramatically.

PROJECTED COST OF SWITCHING

PPG's Natrium, West Virginia facility could be considered a hybrid, with one portion of the plant using mercury and the other portion using mercury-free technology for chlor-alkali production. The newer portion uses diaphragm technology with an estimated capacity of 297,000 tons of chlorine every year,[182] whereas the older mercury-cell portion has 100,000 tons of chlorine capacity per year.[183] The rest of this section focuses only on the mercury portion of the facility. PPG's history of converting mercury-cell chlorine plants aids in arguing for the conversion of the company's Natrium facility. PPG converted its Beauharnois, Canada plant from mercury-cell chlor-alkali production to mercury-free technology in 1990.[184] Converting the plant in Canada and increasing capacity to 88,000 tons of chlorine per year[185] cost PPG $40 million,[186] or about $71.2 million in 2006 dollars.[187]

Although PPG's Natrium facility is larger than its Beauharnois facility was when it converted, costs would not be expected to be significantly more than $71.2 million. The EPA estimates that it could cost a plant $100,000 to $200,000 per ton per day of chlorine capacity to convert to mercury-free technology.[188] Adjusting for inflation, the cost of converting PPG's Natrium facility should range between $43.6 million and $87.3 million.[189] The $71.2 million figure falls well within this range.

PPG has converted other facilities at much higher costs. For example, PPG spent nearly $200 million in the early 1980s to partially install mercury-free technology at its Lake Charles, Louisiana facility[190] (which is now switching completely to the membrane-cell technology at a cost of $90 million) and at the Natrium, West Virginia plant. Since PPG has spent hundreds of millions of dollars in the past in upgrades, a conversion cost of $71.2 million should not warrant sticker-shock for the company. Even though this is no small price, the costs associated with not switching the antiquated facility have been mounting in recent years.

COSTS OF NOT SWITCHING

Using mercury has considerable downsides for companies. Here we look back at costs that PPG's West Virginia plant has incurred in the past due to mercury use. If PPG had switched to mercury-free technology in the past, these costs would have been avoided. Since these costs rival the cost of switching itself, they raise the question of whether sticking with mercury has been a good business decision for PPG. They also argue for switching now, since it is possible that additional costs along these lines could come into play in the future.

Pollution Control Costs

To control air mercury releases, PPG had to install multi-million dollar air pollution controls at its Natrium facility. In 2005, the company announced it had spent nearly $4 million installing additional emission controls,[191] or $5 million in 2006 dollars. Unfortunately, even with this technology in place, mercury will continue to be released from the plant.

Mercury from PPG's facility not only affects the land and air, but it contaminates waterways as well. PPG has been in a legal battle since 2005 concerning its mercury discharges into the Ohio River (See Box 1). The West Virginia Environmental Quality Board (EQB) required that PPG reduce mercury discharges into the river; however, the company claimed it could not reach the lower limits and would be forced to close if such a limit was enforced. The company has appealed this decision, hanging the issue up in court.[192] PPG has been involved in similar permit disputes dating back to 1988.[193] Countless hours and dollars have been spent by PPG to allow the plant to continue to release high mercury loads to the river, though those costs are not included in this analysis.

To get an idea of the possible expense associated with complying with the current permit, we can look to another one of the Filthy Five plants. Ashta's mercury-cell plant in Ashtabula, Ohio was ordered to reduce its mercury discharges to the same level as PPG and spent about $16.9 million to install technology to eliminate mercury discharges.[194] If PPG is to reduce its mercury discharges into the Ohio River as its permit requires, the company may have to pay for additional pollution controls as Ashta already has done. However, installing similar technology would cost approximately $27.5 million in 2006 dollars, not to mention the corresponding annual upkeep of nearly $500,000.[195]

Hazardous Waste Treatment and Disposal

Since PPG's waste is contaminated with mercury, it must be treated as a hazardous waste. In 1992, the United States Environmental Protection Agency mandated that the mercury-cell chlor-alkali plants could no longer dispose of solid waste containing mercury in regular landfills. Several facilities decided to build mercury reprocessing facilities to avoid shipping and disposal costs associated with using hazardous waste landfills. PPG built a reprocessing facility in Lake Charles, Louisiana, near another chlorine plant owned by the company, which is where its Natrium plant ships its mercury-laden hazardous waste. The reprocessing plant cost $5 million in the early 1990s[196] ($8.8 million in 2006 dollars), and processes waste for the West Virginia plant.[197] Meanwhile, since PPG's chlor-alkali facility in Lake Charles, Louisiana, is converting from mercury to membrane-cell technology, the company may need to continue to operate the reprocessing facility just to treat the waste generated in West Virginia. Conversion of the Natrium facility would eliminate both the treatment and facility operating costs for the company.

Summary of Costs

By not converting to mercury-free technology, PPG has spent millions of dollars on pollution control systems and fines, while continuing to emit more than 400 pounds of mercury into the air annually. If PPG had paid upfront the reported amounts here, including research, development, building and maintenance of pollution control technology, and waste disposal, it would have spent more than $13.8 million in 2006 dollars just for these mercury-related expenses. Another nearly $27.5 million could be facing PPG if the company is required to reduce mercury discharges into the Ohio River. Other costs not included in this estimate include those related to worker safety, energy costs and work time spent on litigation, and mercury permitting. The more-than $13.8 million spent on upkeep related to mercury use and possible $27.5 million in additional pollution control would have gone a long way toward paying the $71.2 million estimated costs to switch to mercury-free technology. That switch would also provide substantial financial benefits to the company, not to mention to the environment and public health.

WEST VIRGINIA RIVERS COALITION

SEEKING THE CONSERVATION & RESTORATION OF WEST VIRGINIA'S EXCEPTIONAL RIVERS & STREAMS

Mercury Pollution Persists

In 2005, the Appalachian Center for the Economy and the Environment, on behalf of West Virginia Rivers Coalition, appealed a pollution permit issued to PPG Industries, which allowed the company to continue dumping excessive amounts of mercury into the Ohio River – already the company's practice for more than a decade!

In the summer of 2006, the West Virginia Environmental Quality Board (EQB) ordered PPG to immediately comply with stricter limits and use a more sensitive method for detecting how much mercury it is actually releasing into the river.

However, PPG then appealed EQB's order to the circuit court. Unfortunately, the circuit court judge granted a partial "stay" of the EQB's decision, thereby allowing the company to continue releasing excessive levels of mercury into the river, possibly until 2013.

The circuit court's decision to allow PPG to continue releasing levels of mercury above the state's limits followed a decision by the Ohio River Valley Water Sanitation Commission (ORSANCO) making PPG and other companies potentially eligible for a "mixing zone."

ORSANCO, a commission that recommends water quality rules for the Ohio River, had not previously allowed PPG to receive a mixing zone. But, in the fall of 2006, the commission voted to change its mixing zone rules—making PPG potentially eligible for a mixing zone.

Mixing zones are areas where higher amounts of mercury and other toxins are released into a river with the expectation that the pollution will become diluted as it moves downstream.

ORSANCO's mixing zone rule change may now allow an unknown number of companies to pollute excessively into the next decade. The commission boldly adopted the new rule without actually knowing how many pollution permits may be affected by the change.

Significant amounts of research indicate that mercury causes serious and widespread health effects.

There are fish consumption advisories for every water body in West Virginia because of mercury contamination. The U.S. Environmental Protection Agency stated that in 2004 PPG released about 1,200 pounds of mercury into the air and more than 30 pounds into the Ohio River.

A recent review of PPG's records indicated that the company is still releasing mercury at high levels; in fact, in August, 2006, the company dumped 47 times the average monthly limit allowed by West Virginia's water quality rules.

WVRC will continue to explore options that will require PPG to become mercury free, or at least become a responsible pollution permit holder. [198]

BENEFITS OF SWITCHING

Based on comparisons with the companies that have switched, PPG could achieve considerable financial benefits by doing so. These include increased fuel efficiency, increased capacity and decreased waste management costs.

[✓] Energy Savings

Mercury-cell chlor-alkali production consumes tremendous quantities of electricity and is the most energy intensive way to create chlorine and caustic soda. For example, given PPG's estimated size, the mercury portion of the plant consumes the amount of electricity[199] needed to power nearly 25,000 average homes annually,[200] nearly as many homes as in the state's capital, Charleston.[201] Meanwhile, membrane-cell technology is more energy efficient. When PPG's Beauharnois plant converted, it increased energy efficiency by 35 percent.[202] However, an increase in energy efficiency of about 25 percent is typical. Achieving a 25 percent increase in energy efficiency at PPG Natrium would save enough electricity to power more than 6,100 homes. Assuming a 25 percent savings, if PPG were to switch to membrane-cell technology, the company could save nearly $14.7 million in energy savings over five years.

[✓] Increased Capacity

In addition to increases in energy efficiency, plants tend to increase capacity while installing new membrane-cell technology. When PPG's Beauharnois facility converted, it increased its capacity by 25 percent to 88,000 tons of chlorine per year.[203] If PPG were to expand its Natrium facility by a similar percentage to Beauharnois, Natrium would increase its estimated capacity to 125,000 tons of chlorine per year.[204] This would result in an estimated increase in sales of $82.2 million over five years. Even better, because the manufacturing process would be more efficient, PPG would earn $3.7 million in extra profits over five years from the increased sales due to lower electricity costs.

[✓] Eliminating Mercury Waste Management Costs

Besides the hundreds of pounds of mercury emitted to the air from PPG's Natrium plant every year, the plant also has sent thousands of pounds of mercury contaminated waste to landfills and reprocessing plants for disposal. A European study on mercury-cell chlorine plants estimated that a plant about the same size as PPG's could be expected to pay between €300,000 and €500,000 annually in costs associated with disposal of hazardous waste containing mercury,[205] the equivalent of spending between about $400,000 and $663,000[206] annually on hazardous waste disposal in 2006 dollars.[207] This comes to $2 million to $3.3 million over five years.

[✓] Eliminating Mercury Monitoring and Maintenance

Despite PPG's best efforts to reduce mercury emissions, mercury still escapes, posing a threat not only to the environment, but also to the workers. While maintaining mercury cells properly can reduce releases, plants still need to monitor mercury levels in various media. This includes testing workers,[208] sometimes weekly.[209] A European study estimates that a plant about the same size as PPG's could be spending €300,000 annually in costs associated with monitoring workers and maintaining mercury cells,[210] the equivalent of spending about $400,000[211] in 2006 dollars annually.[212] This comes to about $2 million over five years

"With the tremendous strides made lately, it is becoming difficult to imagine the construction of any new plants utilizing technologies other than the new membrane cell designs…We will be able to take good advantage of membrane cells in their present state of development."

- Paul J. Kienholz, PPG Industries' chlor-alkali business manager, 1983 [213]

MORE THAN 20 YEARS LATER, PPG CONTINUES TO USE OUTDATED MERCURY TECHNOLOGY.

FINAL TALLY

PPG already has shown that it has the ability to shift to membrane-cell technology at its Natrium facility as it has done so already at several other plants. Mercury use not only damages the environment and poses a health risk to employees, but it also costs the company by consuming large quantities of electricity and requiring the utmost care in dealing with hazardous waste created in the process. By using the company's own Beauharnois facility as a model, it could be estimated that switching to membrane-cell technology could increase energy efficiency at the Natrium plant by 35 percent and increase capacity by 25 percent. Here we assume only a 25 percent increase in energy efficiency. Until PPG converts its Natrium facility to mercury-free technology, hundreds of pounds of mercury will continue to be emitted into the air annually and thousands of dollars will continue to be spent unnecessarily to maintain a wasteful technology.

	Cost to Switch:	$71.2 million
	Costs of Using Mercury	$13.8 million
	Potential Water Treatment Bill	$27.5 million
	Benefits (Over 5 years)	
	Energy Savings	$14.7 million
	Waste Disposal	$2 to 3.3 million
	Monitoring	$2 million
	Capacity Increase (Over 5 years)	
	Sales	$82.2 million
	Energy Savings	$3.7 million

174 Adjusted for inflation using the Bureau of Labor Statistics Consumer Price Index to 2006 prices; see, Bureau of Labor Statistics. 2007. "Inflation Calculator." [http://www.bls.gov]. Accessed 5/16/07.

175 Cline, Damon. 2007. "Olin is a Big, Fat (and Completely Legal) Polluter." March 5. [http://blogs2.augusta.com/node/789]. Accessed 4/11/07.

176 Cline, Damon. 2006. "Olin Plans More Bleach Production at Augusta, Ga., Plant." Augusta Chronicle. July 11.

177 Flessner, Dave. 2006. "Olin Doubling Bleach Output: More than $1 Million Being Invested in Charleston Plant." McClatchy-Tribune News. July 11.

178 Boston University. Mercury Wastewater Reduction Program. [http://www.bu.edu/ehs/pollution/mercurywastewater.pdf]. Accessed 4/30/07.

179 Securities and Exchange Commission. 1999. "Arch Chemicals Inc." 10-K405. March 19. [http://www.secinfo.com/dsvrt.61gh.c.htm]. Accessed 5/17/07.

180 United States Environmental Protection Agency. 2007. "PPG Industries (2005)." Toxics Release Inventory. OMB Watch. [http://data.rtknet.org/tri/]. Accessed 4/9/07.

181 Oceana figure using EPA Toxics Release Inventory data.

182 KA Steel Chemicals. 2003. "Plants & Terminals." [http://www.kasteelchemicals.com/map.php]. Accessed 5/14/07.

183 Hwee Sim, Peck. 2005. "PPG To Convert Chlor-Alkali Unit to Membrane Cell Process." Chemical Week. Aug. 10. p. 13.

184 Chemical Week. 1989. "ICI Gets PPG Chlor-Alkali Contract." Sept. 13. p. 3.

185 Financial Post. 1989. "Plant Gets Upgrade." May 2. p.4.

186 Canadian Business. 1993. "Pollution Prevention Pays Big Dividends." March 22. p. 1, 11.

187 Adjusted for inflation using the Bureau of Labor Statistics Producer Price Index to 2006 prices; see, Bureau of Labor Statistics. 2007. "Producer Price Index Industry Data." [http://data.bls.gov/PDQ/servlet/SurveyOutputServlet]. Accessed 5/16/07.

188 Mansfield, Carol; Depro, Brooks; and Perry, Virginia. 2000. "The Chlorine Industry: A Profile Draft Report." U.S. Environmental Protection Agency. August.

189 Adjusted for inflation using the Bureau of Labor Statistics Producer Price Index to 2006 prices; see, Bureau of Labor Statistics. 2007. "Producer Price Index Industry Data." [http://data.bls.gov/PDQ/servlet/SurveyOutputServlet]. Accessed 5/16/07.

190 PR Newswire. 1983. "To Financial." Aug. 31.

191 Ward, Ken Jr. 2005. "Marshall Plant State's Top Mercury Polluter PPG Looses 1,200 Pounds of Deadly Element Into Air Yearly." Charleston Gazette. Aug. 14. p. P1A.

192 West Virginia Rivers Coalition. 2006. "Headwaters." Winter. Vol. 16, Issue 3. [http://www.wvrivers.org/articles/Headwaterswinter2006.pdf]. Accessed 4/16/07.

193 Ward, Ken Jr. 2007. "State Might Relax PPG's Mercury Flow Controls." Charleston Gazette. Feb. 17. p. P1A.

194 Powers, Mary. 1993. "Ohio Chemical Plant Closes Loop to Meet Fed Standards." Engineering News-Record. Sept. 13. p. 16. Business Wire. 2004. "Ashta Chemicals Inc. Makes $6.9 Million Commitment at Ohio Plant." Sept. 21.

195 Adjusted for inflation using the Bureau of Labor Statistics Consumer Price Index to 2006 prices; see, Bureau of Labor Statistics. 2007. "Inflation Calculator." [http://www.bls.gov]. Accessed 5/16/07.

196 Hunter, David; and Martorella, Maurice. 1992. "Mercury Producers Move on Wastes." Chemical Week. May 27 – June 3. p. 9.

197 United States Environmental Protection Agency. 2007. "PPG Industries (2005)." Toxics Release Inventory. OMB Watch. [http://data.rtknet.org/tri/]. Accessed 4/9/07.

198 West Virginia Rivers Coalition. 2006. "Headwaters." Winter. Vol. 16, Issue 3. [http://www.wvrivers.org/articles/Headwaterswinter2006.pdf]. Accessed 4/16/07.

199 The estimated electricity consumption rate is an estimated 2,900 kWh per ton of chlorine produced based on an estimate cited by E. Linak et al., "Chlorine/Sodium Hydroxide," CEH Marketing Research Report, SRI Consulting, August 2005. As cited by P. Maxon in personal communication on June 1, 2007.

200 The average home uses 10,656 kWh of electricity per year; see, United States Department of Energy. 2001. "Total Energy Consumption in U.S. Households by Four Most Populated States." Table CE1-7c. [http://www.eia.doe.gov/emeu/recs/recs2001_ce/ce1-7c_4popstates2001.html]. Accessed 5/11/07.

201 US Census Bureau. 2000. "State & County QuickFacts." [http://quickfacts.census.gov/qfd/states/54/5414600.html]. Accessed 4/28/07.

202 Canada NewsWire. 1992. "1992 Energy Efficient Industrial Award Winners." June 11.

203 Financial Post. 1989. "Plant Gets Upgrade." May 2. p.4.

204 KA Steel Chemicals. 2003. "Plants & Terminals." [http://www.kasteelchemicals.com/map.php]. Accessed 5/14/07.

205 European Environmental Bureau. 2006. "Status Report: Mercury Cell Chlor-Alkali Plants in Europe." October. Costs may vary slightly from the U.S.; however, disposal practices are similar and U.S. cost estimates are not available.

206 FXHistory. “Historical Currency Exchange Rates.” Conversion Table: EUR to USD (Interbank rate). Jan. 1, 2004 - Dec. 31, 2004. [http://www.oanda.com/convert/fxhistory]. Accessed 6/1/07.
207 Adjusted for inflation using the Bureau of Labor Statistics Consumer Price Index to 2006 prices; see, Bureau of Labor Statistics. 2007. “Inflation Calculator.” [http://www.bls.gov]. Accessed 5/16/07.
208 Occupational Safety & Health Administration. “CPL 02-02-006 - CPL 2-2.6 - Inorganic Mercury and its Compounds.” US Department of Labor. [http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=DIRECTIVES&p_id=1573]. Accessed 6/7/07.
209 Davis, Michael. 2005. “Olin Plant Has History of Pollution Infractions.” Chattanooga Times Free Press. Jan. 29. p. B2.
210 European Environmental Bureau. 2006. “Status Report: Mercury Cell Chlor-Alkali Plants in Europe.” October.
211 FXHistory. “Historical Currency Exchange Rates.” Conversion Table: EUR to USD (Interbank rate). Jan. 1, 2004 - Dec. 31, 2004. [http://www.oanda.com/convert/fxhistory]. Accessed 6/1/07.
212 Adjusted for inflation using the Bureau of Labor Statistics Consumer Price Index to 2006 prices; see, Bureau of Labor Statistics. 2007. “Inflation Calculator.” [http://www.bls.gov]. Accessed 5/16/07.
213 PR Newswire. 1983. “To Financial.” Aug. 31.
214 United States Environmental Protection Agency. 2007. “Erco Worldwide (USA) Inc.” Toxics Release Inventory. OMB Watch. [http://data.rtknet.org/tri/]. Accessed 4/9/07.
215 Schmid, John. 2006. “Focus Is On Mercury Emitter.” Milwaukee Journal Sentinel. Aug. 8.
216 Associated Press. 2007. “Wisc. Won’t Back Utility Rate Relief.” Jan. 12. [http://www.abcmoney.co.uk/news/1220075398.htm]. Accessed 4/17/07.
217 United States Environmental Protection Agency. 2007. “Erco Worldwide (USA) Inc.” Toxics Release Inventory. OMB Watch. [http://data.rtknet.org/tri/]. Accessed 4/9/07.
218 Chlor-Alkali Marketwire. 2005. “Market Assessment.” April 15. Vol. 18, No. 15.
219 United States Environmental Protection Agency. 2006. “Great Lakes Binational Toxics Strategy.” Dec. 7. [http://www.epa.gov/glnpo/bns/reports/stakedec2006/minutes/dec07_06.html]. Accessed 4/17/07.
220 Hellpap, Andrew. 2007. “ERCO Tech Project in Limbo.” Wisconsin Rapids Daily Tribune. March 15. [http://www.wisconsinrapidstribune.com/apps/pbcs.dll/article?AID=/20070315/WRT0101/703150439/1805/WRT01]. Accessed 4/17/07.
221 Ibid.
222 Fair Disclosure Wire. 2007. “Q4 2006 Superior Plus Income FD Earnings Conference Call - Final.” March 7.
223 Baumgarten, Stefan. 2005. “Canada’s Superior Erco Buying US-based Chloralkali Business.” Chemical News & Intelligence. April 21.
224 PR Newswire. 1980. “To Financial.” Jan. 31.
225 United States Environmental Protection Agency. 2006. “Cleanup of Mercury-Contaminated Chlor-alkali Sites.” [http://www.epa.gov/epaoswer/hazwaste/mercury/cleanup.htm]. Accessed 4/17/07.
226 Content, Thomas. 2007. “Firm Won’t Get Deal On Rates.” Milwaukee Journal Sentinel. Jan. 12. P. 1.
227 Ibid.
228 ERCO Worldwide. 2006. “6680-UR-115 Rate Intervention and Special Rate Request.” Sept. 12.
229 The average home uses 10,656 kWh of electricity per year; see, United States Department of Energy. 2001. “Total Energy Consumption in U.S. Households by Four Most Populated States.” Table CE1-7c. [http://www.eia.doe.gov/emeu/recs/recs2001_ce/ce1-7c_4popstates2001.html]. Accessed 5/11/07.
230 U.S. Census Bureau. 2000. “State & County QuickFacts.” [http://quickfacts.census.gov/qfd/states/55/5560500.html]. Access 4/27/07.
231 ERCO Worldwide. 2006. “6680-UR-115 Rate Intervention and Special Rate Request.” Sept. 12.
232 Newman, Judy. 2007. “Chemical Firm Eyes Options.” Wisconsin State Journal. Jan. 13. p. D10.
233 European Environmental Bureau. 2006. “Status Report: Mercury Cell Chlor-Alkali Plants in Europe.” October. Costs may vary slightly from the U.S.; however, disposal practices are similar and U.S. cost estimates are not available.
234 FXHistory. “Historical Currency Exchange Rates.” Conversion Table: EUR to USD (Interbank rate). Jan. 1, 2004 - Dec. 31, 2004. [http://www.oanda.com/convert/fxhistory]. Accessed 6/1/07.
235 Adjusted for inflation using the Bureau of Labor Statistics Consumer Price Index to 2006 prices; see, Bureau of Labor Statistics. 2007. “Inflation Calculator.” [http://www.bls.gov]. Accessed 5/16/07.
236 Occupational Safety & Health Administration. “CPL 02-02-006 - CPL 2-2.6 - Inorganic Mercury and its Compounds.” US Department of Labor. [http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=DIRECTIVES&p_id=1573]. Accessed 6/7/07.
237 Davis, Michael. 2005. “Olin Plant Has History of Pollution Infractions.” Chattanooga Times Free Press. Jan. 29. p. B2.