

**A GUIDE TO MERCURY REDUCTION IN  
INDUSTRIAL AND COMMERCIAL  
SETTINGS**

**A Joint Effort By:**

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system disorders, kidney and liver damage and impaired childhood development. Nervous system disorders include impaired vision, speech, hearing and coordination.<sup>2</sup>

Mercury has many applications in industry due to its unique properties, such as its fluidity, uniform volume expansion over the entire liquid temperature range, high surface tension, electrical conductivity and its ability to alloy with other metals. A wide variety of industries including electrical, medical, chemical and mining utilize mercury. Such commercial uses of mercury include barometers, thermometers, switches, fluorescent lamps, and mercury arc lamps.

Mercury has been identified as a “critical pollutant” under the Great Lakes Water Quality Agreement (GLWQA) due to its (1) presence in open lake waters, (2) ability to cause or contribute to failure to meet Agreement objectives, and (3) potential to bioaccumulate. Under the GLWQA, Canada and the United States agreed to develop, in consultation with state and provincial governments, Lakewide Management Plans (LaMPs) to address the critical toxic pollutants that contribute to ecological impairments in each Great Lake. Each LaMP focuses on substances such as mercury that persist at levels that are causing or are likely to cause impairments.

In recent years, there has been a focus on reducing the use of mercury in products and reducing air emissions that are greater than what is necessary to protect public health. In 1997, the United States and Canada signed the Binational Toxics Strategy Agreement, which seeks to achieve, by 2006, a 50% reduction in the deliberate use of mercury in the United States as well as a 50% reduction in releases of mercury to the atmosphere.<sup>3</sup> Mercury is identified as a “Tier 1” pollutant in this agreement, making it a top priority for coordinated efforts between the two countries to reduce its use and release.

#### Voluntary Approach to Mercury Reduction

Starting in 1998, Bethlehem Steel Burns Harbor, Ispat Inland Inc. Indiana Harbor Works, and U.S. Steel Gary Works, all Northwest Indiana integrated steel mills, have been participants in a Mercury Pollution Prevention Initiative. The key objectives of this initiative are:

- ◆ Identify mercury uses and quantities within each facility;
- ◆ Identify mercury in the waste stream; and
- ◆ Determine and implement mercury pollution prevention options including on-going management of mercury, recycling, and substitutions.

The expected results of this effort include elimination of mercury use to the extent practicable, consolidation and better management of mercury, replacement of equipment containing mercury, establishment of purchasing policies, and development of educational initiatives for facility employees.

The recognition by state and federal environmental agencies that mercury is a priority chemical of concern affecting both the health of people and the degradation of the environment results in the need to phase out the use and release of mercury to the greatest extent possible. All parties

agree that an effective way to achieve further mercury reductions is through voluntary partnerships involving sources of mercury.

By definition, voluntary efforts are those that go beyond existing legal requirements. Voluntary agreements, such as the Mercury Pollution Prevention Initiative, challenge potential sources of a pollutant(s) to design and carry out their own tailored, cost-effective prevention and/or reduction programs. Rather than requiring formal, complicated contracts with government agencies, these voluntary agreements can be simple and flexible.

Benefits of voluntary pollution prevention efforts to companies include:

- Voluntary participation can provide the best opportunity for cost-effective reductions.
- Participation can be beneficial to a company's image in the community and with environmental regulators.
- Lack of participation may increase the chances of mandatory reductions being required in the future through other regulatory programs.
- Avoiding the costs associated with the use of mercury, such as disposal or recycling, collection and storage prior to disposal, paper work for tracking hazardous waste disposal and liability for environmental problems or worker exposure, can be economically beneficial.
- Reducing or eliminating mercury can minimize mercury spills, their attendant clean-up costs and worker exposure.
- Participation in pollution prevention efforts that both protect the environment and improve worker safety can raise employee awareness and improve morale.

The concept of using voluntary agreements to work toward reducing use or releases of pollutants has been applied in a variety of source sectors, including printing, automobile manufacturing and metal finishing among others. For example:

- The chlor-alkali industry has committed to a 50% reduction in mercury use over 1990-1995 average levels by 2005.
- The American Hospital Association has agreed to virtually eliminate use and release of mercury from member facilities also by 2005.
- The three largest U.S. thermostat manufacturers have developed a mercury thermostat take-back program through a reverse distribution system involving HVAC contractors and wholesalers.
- Automobile manufacturers have committed to phasing out use of mercury switches for convenience lighting and antilock braking systems.

In addition, outreach programs are targeting proper management and recycling of dental amalgam and elimination of mercury use in schools. Table 1 provides a list of current, voluntary mercury reduction efforts taking place in the Great Lakes basin and beyond.

**Table 1**

**Voluntary Mercury Reduction Efforts in the Great Lakes Basin**

(Adapted from: The Great Lakes Binational Strategy: Draft Progress Report—November 16, 2000)

Northwest Indiana Steel Mill Agreement  
Health Care Memorandum of Understanding (Canada)  
Hospitals for a Healthy Environment (U.S.)  
Wisconsin Communities Mercury Reduction Program  
Western Lake Superior Sanitary District Mercury Zero Discharge Project  
Michigan Mercury Pollution Prevention Task Force  
Detroit Water and Sewerage Department Mercury Minimization Program  
Dairy Manometer Replacement Programs (Wisconsin and Michigan)  
Thermostat Recycling Corporation Initiative  
Automobile Pollution Prevention Project  
Electric Utility Mercury P2 Initiatives (Consumers Energy Company,  
Detroit Edison and Wisconsin Electric)  
Great Lakes Dental Mercury Reduction Project  
Chlor-Alkali Industry Mercury Reduction Initiative

Many non-essential uses of mercury have been discontinued. Many mercury source sectors are currently implementing voluntary mercury reduction programs. The time is right for all significant users of mercury to evaluate alternatives and phase out mercury use consistent with voluntary, cost effective business practices.





part of a larger environmental management system (EMS) at the plant, and is currently being incorporated into the facilities' ISO 14001 plan. (See Appendix B) Management should also consider connecting the mercury reduction effort with state and/or federal environmental agency pollution reduction initiatives. Such collaboration may provide opportunities for technical assistance, positive formal recognition and enhancement of relationships with these agencies.

Figure 2 provides a sample "Mercury Pledge Form" which may be useful in formalizing your company's mercury reduction commitment and communicating it to both suppliers and clients.

Figure 2

## MERCURY PLEDGE

We pledge to continue to seek out opportunities to reduce or eliminate mercury in raw materials, equipment and products. As a participant in this pledge program, we will:

- **Identify mercury in our facilities and in the products we make.**
- **Evaluate nonmercury alternatives and phase in as many as possible as soon as possible.**
- **Develop and implement a mercury reduction plan and report on our results.**
- **Establish purchasing policies relating to mercury.**
- **Inform and educate staff, suppliers and clients about mercury issues and nonmercury alternatives.**

Company Name \_\_\_\_\_

Address \_\_\_\_\_

Contact Person \_\_\_\_\_

Telephone, Fax and Email \_\_\_\_\_

Signed by:

---

Company President or Facility Manager

---

Date

**Start reducing mercury right away.** It isn't necessary to complete an inventory before you start eliminating mercury from your facility. There are probably some obvious, nonessential uses or sources of mercury that can be addressed immediately while you are evaluating overall mercury use. Do you have any mercury that is just "laying around"—bulk mercury that has been stored and added to over the years and no one knows why or mercury sitting in an old or abandoned laboratory? Check those basements and storage rooms for retired equipment containing mercury that was never disposed of or old mercury compounds that have been sitting on a shelf for decades. Picking off such "low hanging fruit" can get your mercury reduction program off to a fast start.

**Identify mercury sources.** Consider conducting a two-stage inventory—an initial, screening inventory to let you generally know what and how much. PoTJ—ch (o8(.1( on4entgenerudgen,n gento

mercury reduction efforts, estimate potential costs in terms of extra staff time and delays, and then weigh these benefits and costs to decide if a mass balance approach is worthwhile. Keep in mind that a mass balance is only as accurate as the analytical data used to construct the balance model.

Remember—it is important to be both systematic, and pragmatic. Mercury may be found in raw materials, equipment, storage areas and waste streams and you need to evaluate each of these logically and comprehensively. Regardless how extensive and detailed your inventory is, it is critical to keep good, consistent records across your facility and incorporate them into a database that works for you.

**Evaluate nonmercury alternatives.** Use information from this report and elsewhere to learn more about mercury-free substitutes for the mercury-containing equipment and materials identified in your inventory. Suppliers can also assist you in finding mercury-free alternatives. Questions to ask when comparing a mercury-containing product and a mercury-free substitute include:

- Can a process or procedural change be implemented to eliminate the mercury source?
- Is the performance of the substitute as good as the mercury-containing product?
- If the performance is not as good, is it adequate for the purpose?
- What are the costs for purchase, calibration, maintenance and disposal?
-

- Evaluation and implementation of mercury recycling options;
- New or revised policies for various departments, including process design, purchasing, maintenance and waste management;
- Staff training programs;
- Prioritization of mercury sources for removal with schedules;
- Regular progress reviews; and
- Communication of results.

The plan should identify specific action steps and determine time lines for implementation. Time frames should be realistic and must account for time spent researching the availability of alternative products and equipment and training personnel in their installation and/or use

**Undertake a pilot project.** Sometimes, it just isn't feasible to implement a whole facility approach right away. Instead, a department-by-department or building-by-building approach may fit better into your budgeting and priorities. Consider an initial pilot project that is doable, has support for its implementation, and one that indicates a high potential to succeed. The success and lessons learned from this initial pilot project can bolster support for your next mercury reduction project. Taking on the whole project from the start may result in failure, causing people to give up on the whole program.

Use the information from the pilot project to choose a new project or expand the first one. If you switched one building or process line over to mercury-free equipment, decide which should be switched over next. If you specified mercury-free equipment in your last purchase order, consider creating a mercury-free policy for all future purchase requests.

For example, one of the mills involved here began with an edict from the purchasing department that only low mercury nonhazardous fluorescent light bulbs can be purchased.

**Establish purchasing policies.** Consider a policy that bans the purchase of any mercury-containing item if an adequate alternative exists. The policy could include a requirement for specific authorization by the plant manager or CEO for the purchase of any mercury-containing product.

Authorize the purchasing department to make "mercury-free" a part of product specifications and to require mercury disclosures on all products coming into your facility. Policies such as this will eventually make it a competitive issue for vendors to ensure that they can provide mercury-free alternatives. Ask your vendors to verify in writing that their products are mercury-free or that they will assist you in selecting mercury-free products. For laboratory and process chemicals, a Certificate of Analysis can be requested. (See Figure 3)

**Inform and educate staff.** Employee education in mercury pollution prevention can be an important component of a successful program. Communicate the mercury reduction program process and goals to employees and solicit employee input. Determine which groups within your facility need information and/or training and identify the most important topics for each

group. Try to incorporate mercury pollution prevention into existing information and training programs such as new employee orientation, safety training, right-to-know training and department meetings. Other outreach techniques include:

- Displays in cafeteria or other common areas
- Employee survey about mercury awareness
- Articles in internal newsletter
- Employee handbook page on guidelines for handling and disposing of mercury
- Posters and fliers
- Labels on equipment that contain mercury
- Incentive program to reward good ideas that make mercury reduction easier

**Implement, review and adjust.** When all is ready, implement your overall mercury reduction program. The plan should identify specific action steps and determine time lines for implementation and be subject to periodic review and revision. It should also address new or revised policies relating to:

- Maintenance and handling of mercury-containing products and equipment;
- Mercury spill prevention and management;
- Recycling or disposal of mercury-containing products;
- Purchasing of mercury-containing products; and
- Phase out during retrofitting or new facility construction.

The mercury reduction team should meet throughout the project to evaluate any problems and adjust course, as needed. Involve staff in a climate that encourages input and feedback regarding inventory and reduction methods, new products or equipment. Make sure the team weighs the feedback during the evaluation process. Don't be surprised if things get behind schedule--sometimes it may take longer than expected to find a new product or arrange for training.

**Celebrate success.** As you accomplish each goal, celebrate success! Find a way to communicate your initial success and future plans to the entire facility or company. Track how much mercury you have recycled and publicize your results. Make sure the public relations department gets information it can share with the community. Place information about your mercury reduction program prominently on your company web site. Also, consider sharing your accomplishments with other facilities in your corporation, community and trade association.

### Finding It—The Mercury Inventory

This section provides some more detailed information for mercury inventories of purchased materials and equipment. Table 2 provides the mercury inventory instructions issued by one of the participating steel mills. Table 3 is a blank form for inventorying mercury devices and liquid mercury and Table 4 is a similar blank form for mercury containing materials. These guides may be helpful when you customize inventory materials to fit with your business, inventory strategy, targets and goals.





**Table 3**

**MERCURY INVENTORY:**  
Mercury Containing Devices and Liquid Mercury  
(In Use or Storage)

**Business Unit:**

**Date:** / /

Item (Description)	Data/Info Source	Devices				Location		Comments
		Quantity	Weight Each	Est. Tot. Hg (lbs)	Est. Tot. Hg (gm)	Operating Unit/ Storage location		

**Table 4**  
**MERCURY INVENTORY:**

Mercury Containing Materials  
(In Use or Storage)

**Date:**    /    /

Item (Description)	Data/Info Source	Materials				Location Operating Unit/ Storage location	Comments
		Quantity	Hg Conc. (PPM)	Est. Tot. Hg (lbs)	Est. Tot. Hg (gm)		

### **Mercury in Purchased Materials**

Widely used industrial chemicals such as caustic soda (sodium hydroxide) and sulfuric acid may contain mercury below the 10,000 parts per million (1%) listing requirement for Material Safety Data Sheets but in concentrations high enough to affect the environment or exceed wastewater regulatory requirements. The mercury content of caustic soda and sulfuric acid is dependent upon the manufacturing process. Caustic soda can be produced by the electrolysis of salt brine using the porous-diaphragm process, ion-exchange membrane process or the mercury-cell process. Most caustic soda is produced using the diaphragm process, however the mercury-cell process produces 13 % of all caustic soda available in the market place.

The mercury cell process uses mercury as a cathode and caustic soda produced by this process can contain mercury in the hundreds of parts per billion range. Eleven chemical plants in the United States use the mercury-cell process. Mercury grade caustic soda is high quality (low salt) and is more expensive than diaphragm-grade caustic. Typically, mercury grade caustic soda and membrane grade caustic soda (also high quality) are used for water conditioning for boilers, ion-exchange regeneration and other processes requiring low-salt caustic soda.

Other chemicals manufactured by the mercury-cell process include potassium hydroxide, chlorine, and muriatic acid. In addition, sulfuric acid produced as a secondary product of lead and copper smelting can contain mercury up to 10,000 parts per billion range. Table 5 contains a list of additional industrial chemicals that may contain mercury.

**Table 5**  
**MERCURY-CONTAINING CHEMICALS**  
**IN THE INDUSTRIAL SETTING**

(Source: A Business Guide to Conducting a Mercury Audit, P3ERIE)

- ◆ Catalysts for Urethane and Vinyl Production
- ◆ Electroplating Solutions and Processes: Zinc-mercury plating, steel coloring, mercuric chloride, mercuric sulfate, mercuric nitrate, mercuric cyanide, mercuric oxide and mercuric dichromate have been used in the metal finishing industry.
- ◆ Caustic soda
- ◆ Sulfuric acid
- ◆ Potassium hydroxide
- ◆ Muriatic acid
- ◆ Ferric chloride.
- ◆ Laboratory Chemicals: mercury chloride, mercury (II) chloride, mercury iodide, mercury nitrate, mercury (II) oxide, mercury (II) sulfate, nessler reagent, zenker's solution and dozens of other less commonly used laboratory chemicals.

Although the mercury concentrations in these industrial chemicals may be relatively low, the total mass of mercury in your facility's waste streams can be large. The mercury may be discharged in wastewater effluent and/or released into the air during the wastewater treatment process or if wastewater sludge is land spread or incinerated.

Industrial users of caustic soda can review and amend their specifications to ensure that low mercury caustic soda is used. Mercury levels in raw materials can vary significantly depending upon the source. Industries can specify low-mercury chemicals and request certificates of analysis from all chemical suppliers when purchasing materials. Similarly, facilities should evaluate their uses and sources of other industrial chemicals that may contain mercury. Figure 3 provides an example of a letter requesting a certificate of analysis and Figure 4 provides an example of such a certificate.

**Figure 3**  
**Sample Letter to Supplier Requesting Certificate of Analysis**  
(Source: Western Lake Superior Sanitary District)

**Figure 4**  
**Sample Certificate of Analysis**  
(Source: Western Lake Superior Sanitary District)

Anderson's Acid  
98 Molarity Drive  
Marathon, Ontario  
H2S 04 CANADA

Customer : Acme Manufacturing, Inc.

Attn: John Jefferson  
Fax: 1-800-555-5555

Product Grade : SULFURIC ACID 93%  
B/L number : 00008650

Shipment Date : 09/03/96  
Quantity (as is): 100.400  
T

Customer P/O No.: C125062  
Routing : ONR-HEARST-AC-SSTMA-WC-SUPER-BN-CLOQ-DNE  
Tank Car/Tank Truck No. :  
UTLX125021

## **Mercury in Equipment**

Many types of industrial equipment contain mercury, including electrical equipment, measurement and control instruments, batteries and lamps. Consumer and medical use of mercury-bearing equipment is decreasing, however industrial use remains high. The total

**Table 6**  
**MERCURY-CONTAINING EQUIPMENT**  
**IN THE INDUSTRIAL SETTING**

(Source: A Business Guide to Conducting a Mercury Audit, P3ERIE)

- Accustats
- Barometers
- Batteries: mercuric oxide, mercury-zinc and mercury-cadmium
- Catalysts for Urethane and Vinyl Production
- Counterweights
- DC Watt-Hour Meters
- Displacement/Plunger Relays
- Elemental Mercury for refilling mercury-containing equipment.
- Flame Sensors: sometimes found in the pilot light and burner assembly on gas-fired furnaces, boilers, unit heaters, space heaters, industrial ovens and in central air conditioning systems.
- Flow Meters
- Gas Extraction Apparatus
- Gas Regulators
- Gyroscopes
- Hydrometers with thermometers
-





**TABLE 8**

ISPAT INLAND INC. INDIANA HARBOR WORKS INVENTORY OF MERCURY AND MERCURY- CONTAINING EQUIPMENT/DEVICES		DEPARTMENTAL SUMMARY: <b>#7 Blast                      Furnace</b>					
Description of Item	Item Location and/or Function	Manufacturer / Supplier	Manufacturer's Part and/or Model Number	Ispat IPN Number	Mercury Content Per Item	Total Number of Items	Total Mercury (Pounds)
LAMPS: (Fluorescent)	Various	GE / Graybar	F40LW/RS/WM	15053	30mg	2,047	0.13



## Resources to Assist Your Mercury Reduction Efforts

The good news is that you don't have to start from scratch in terms of your mercury reduction efforts. Others have done it and are doing it and there is no need to relearn what they have learned. Certainly, no two facilities are the same, and you will have to tailor your efforts to your operations and your mercury usage, however there are probably similarities between your facility and your mercury usage and those of others that can help to inform your mercury reduction efforts.

This report can provide guidance for finding and inventorying the mercury at your facility. Also, most states have pollution prevention technical assistance providers available to assist your efforts at little or no cost. For example, in Indiana, home of the three steel mills that participated in the Mercury Pollution Prevention Initiative, the Indiana Department of Environmental Management maintains an Office of Pollution Prevention and Technical Assistance. In other states, such as Illinois and Wisconsin, pollution prevention technical assistance is provided separate from the environmental regulatory agency (at the Illinois Waste Management and Research Center and University of Wisconsin Solid and Hazardous Waste Education Center, respectively).

For information on removing the mercury from equipment, vendors and waste contractors may be able to provide assistance. For recycling, disposal and transportation of mercury, waste contractors, mercury recyclers, state environmental agencies and local or regional solid waste management agencies can help. For information on alternatives to mercury-containing products and equipment, this report, vendors and technical assistance providers can be sources of useful information.

Keep in mind that the "Universal Waste Rule" (40 CFR Part 273) which relaxes RCRA requirements relating to storage and transportation of certain hazardous wastes in order to promote recycling, may apply to some of the mercury products and equipment that you are trying to dispose or recycle. The list of universal wastes varies from state to state but may include fluorescent lamps, thermostats, switches and other mercury-bearing equipment.

Universal wastes are certain commonly generated hazardous wastes that are subject to somewhat less stringent Federal and State regulations in terms of handling and storage times (you can store them onsite longer than other hazardous wastes). The regulations are designed to encourage the proper collection and recycling of these widely used materials. They include:

- Batteries
- Certain pesticides
- Mercury thermostats
- Mercury lamps (such as fluorescent tubes)

At Ispat Inland, Policy and Procedure P-019 specifically outlines the required method for collecting and disposing/recycling these wastes. Essentially, a plant coordinator has been

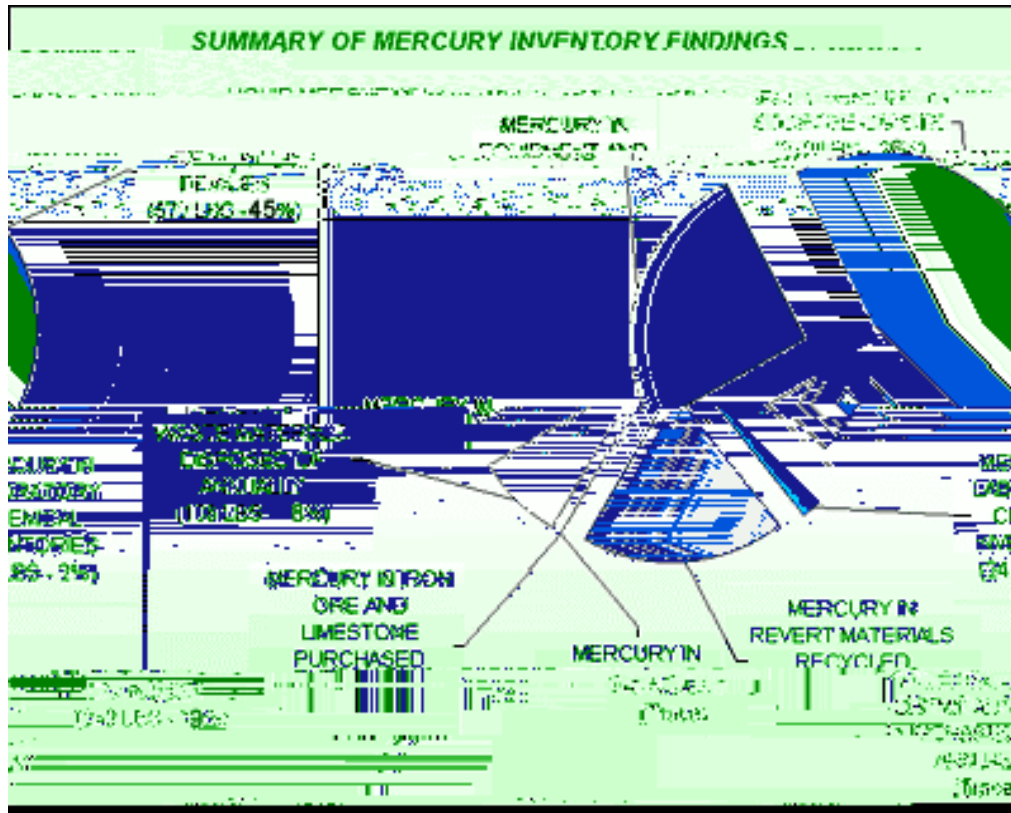
assigned responsibility for picking up all Universal wastes, and a Universal waste storage area has been established in the plant. Operating personnel are directed as to how the materials are to be packaged prior to calling for pickup. Once collected, they are stored onsite until a large enough number exists to warrant a truck shipment offsite to a recycler or to disposal.

An excellent fact sheet on Universal Waste can be found on the Internet at [www.afcee.brooks.af.mil/pro-act/fact/jun00.asp](http://www.afcee.brooks.af.mil/pro-act/fact/jun00.asp).

### **III. Results of The Steel Mill Voluntary Mercury Reduction Effort**

The purpose of this section is to share the experiences and results of the three Northwest

Figure 5



There was an additional 330 pounds of mercury in temporary storage at the time of the inventory, including mercury that had been removed from obsolete equipment. Approximately 24 pounds was in laboratory chemical inventories, and another 242 pounds was estimated to be in revert (recycled) materials that circulate in the process and never leave the three plants. Mercury content of purchased chemicals, iron ore and limestone was found to exist in trace amounts only.

### Mercury in Purchased Materials

The mills conducted an initial survey of the mercury content of purchased materials based on a thorough review of Material Safety Data Sheets (MSDS), literature review and discussions with vendors. They concluded that the MSDS does not typically provide the detail and detection limit required by this inventory, i.e. if mercury is present at less than 1 percent the MSDS may not indicate its presence.

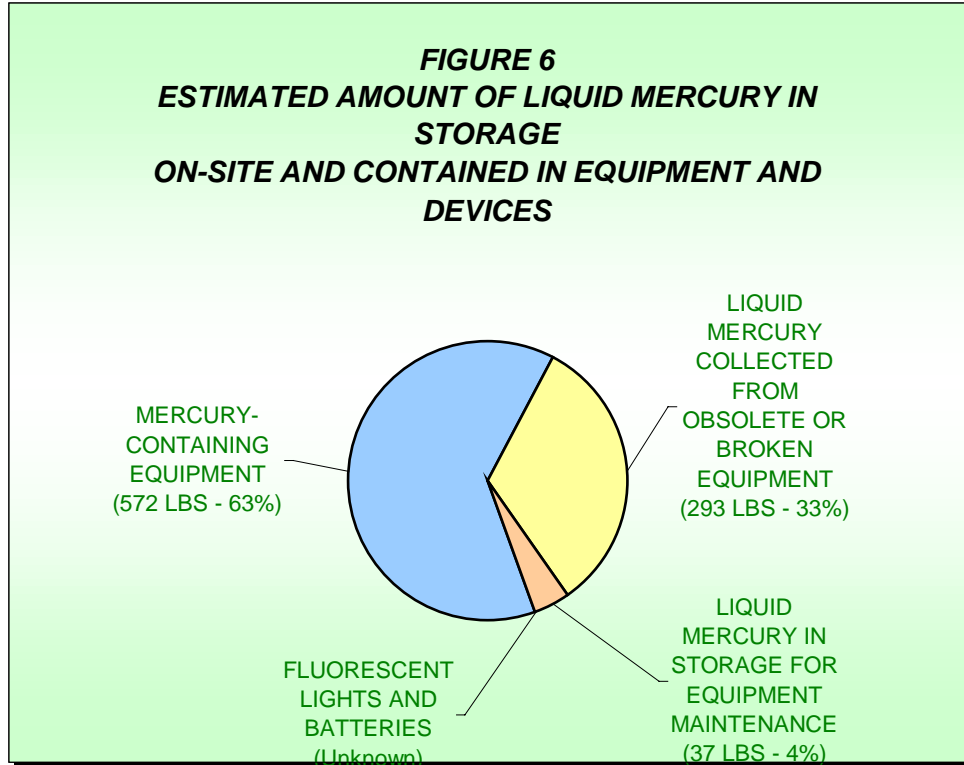
This left discussions with vendors and use of generally available industry data as key sources of information. Typically, vendors could not provide specific mercury content and could only provide ranges. As interest in reducing mercury use in industrial processes increases, it will be necessary for manufacturers and suppliers to provide more accurate mercury content information.

The three mills used a contractor to collect mercury content information for the chemicals and raw materials that they use. Sources of information consulted included: vendor lists supplied by the three steel companies; input from USEPA, U.S. Geological Survey and state agency staff; internet web sites, technical data bases, and other sources.

Testing of certain raw materials purchased in large quantities (i.e. iron ore and limestone) was also performed. Considerable time was spent discussing coal but it was ultimately eliminated

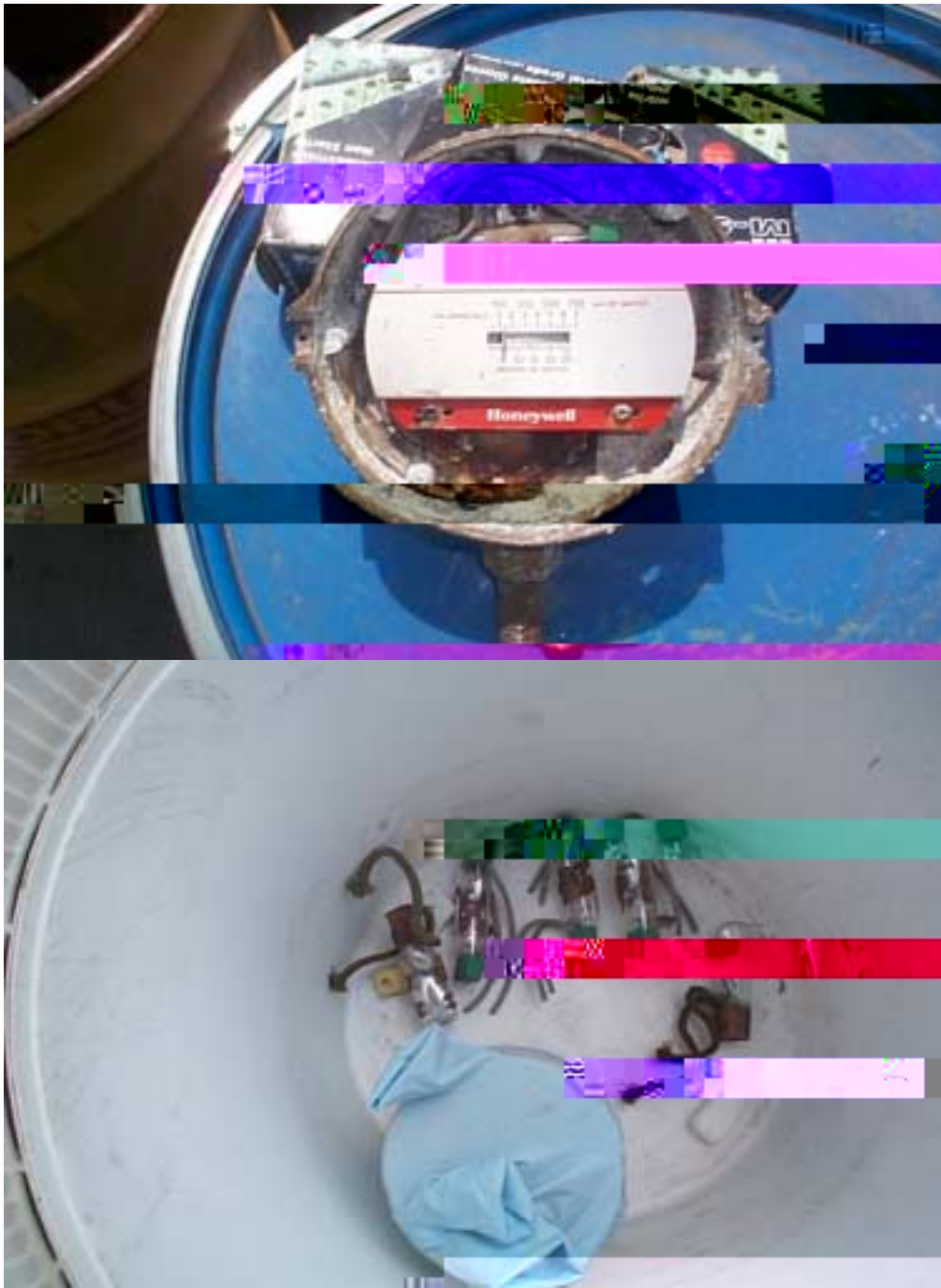


various mercury containing devices used at the three facilities, including amounts of liquid mercury in storage.



What USEPA categorizes as Universal Wastes (fluorescent lights, batteries and thermostats that

**FIGURE 7 -MERCURY PRESSURE SENSING DEVICE**



Ignitrons are another good example of mercury-containing devices in use in older facilities in these mills. An ignitron is a rectifier that is used to change alternating current (AC) into direct current (DC). Many motors use DC current, which allows them to run at variable speeds. Figure 8 – Ignitron Rectifiers provides a picture of four such ignitrons in use at one of the mills’ steel cold rolling facilities. These units were recently replaced with solid-state rectifiers that do not contain mercury. Approximately 10 pounds of mercury was safely removed from service through this replacement.

**FIGURE 8 - IGNITRON RECTIFIERS**



The detailed, exhaustive inventory for mercury devices and their non-mercury replacements has turned out to be a much more time consuming, lengthy process than was originally estimated. Many thousands of these devices exist in the plants and it is taking hundreds of worker hours to locate and inventory these devices. However, this approach is the only way to systematically identify and track all of the mercury devices in these plants. Completion of the survey at the three facilities is expected by June 2001. The fact that the inventory is not complete has not, however, delayed work on replacement of mercury-containing devices. All three mills are currently working with operating personnel to determine the most high risk and high quantity mercury-containing devices in an effort to prioritize equipment replacement.

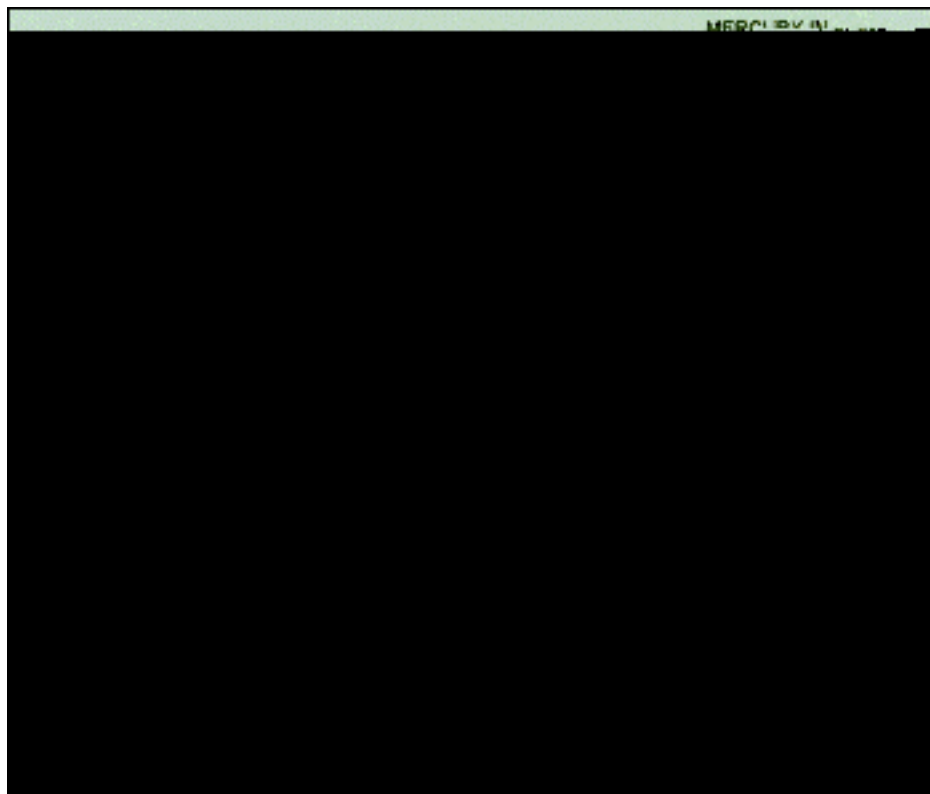
#### Mercury in Waste Streams and Non-Product (Revert) Outputs

This third category of the mercury inventory required the largest amount of sampling in the three facilities--40+ revert and waste streams had to be evaluated. These revert and waste streams are generated mostly from air and water pollution control devices, and screening equipment used to size the reverts. Most are reused back into the iron and steel making process, usually in the sinter plant, which makes solid chunks out of waste dusts and sludges for reuse in the blast furnaces. Those dusts and sludges that have been historically reused in the process, for

example blast furnace flue dust, blast furnace scrubber sludge, and mill scale are referred to as "revert" materials. Essentially, contaminants such as mercury that may be present in these reverts circulate in the process--sinter is sent to the blast furnace; iron from the blast furnace is sent to the basic oxygen furnace shops for further refining, and waste dusts and sludges from the blast furnaces and some from the basic oxygen furnace shops are sent back to the sinter plant for reuse.

Waste streams generated from the coke, iron and steel making processes were sampled and analyzed. Mercury concentrations in waste materials ranged from less than 0.01 mg/kg (parts per million) in some blast furnace and steel making shop pollution control dusts and sludges to 6.074 mg/kg in some sinter plant pollution control residues. The total annual quantity of mercury present in these wastes is approximately 348 pounds. However, many of these materials are reused (such as materials recycled to the sinter plant as described above), resulting in a total of 106 pounds per year of mercury present in materials which are disposed of either onsite or offsite in permitted landfills. The results for mercury in waste streams are summarized in Figure 9. Not shown (because they are never disposed of) are 242 pounds contained in the constantly recycled revert materials.

**Figure 9**  
**Estimated Mercury in Waste Streams**



## Mercury Reduction Plan

During the course of the initial inventory at the three steel mills, it became apparent that mercury exists in varying quantities in thousands of devices currently in operation. Some of these devices, such as fluorescent lights, hold minuscule quantities of mercury, while others, such as large ignitrons, can hold many pounds each. The mercury reduction team concluded that it would be physically and economically prohibitive to embark on an immediate replacement program for all mercury containing devices currently in operation. In addition, by their design and nature, mercury-containing devices are often very reliable, operating for years without failure. For example, some ignitron tubes installed at the mills in the 1930s remain totally functional and reliable today.

However, the team identified and began a program to remove mercury from sensitive areas, such as next to waterways. This effort, in conjunction with replacement of failed or out-of-service devices, will lead to continued significant mercury removal. Some devices on older units that reside at locations of little environmental risk will remain in service as long as they remain functional. For this reason it will take many years to complete 1930s rem( Fs5( igy)15.2( )TJt0. ill

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reduction effort). The three companies intend to annually report on progress in meeting these goals at regional, national or international conferences to update all interested parties.

## **References**

1.

14. *Reducing Mercury Use in Health Care: Promoting a Healthier Environment.* Monroe County (NY) Department of Health. .4957 5



# Appendix A

## Mercury Pollution Prevention Initiative Voluntary Agreement

Between

**The Lake Michigan Forum, Indiana Department of Environmental Management, U.S. Environmental Protection Agency And Bethlehem Steel Burns Harbor, Ispat Inland Inc. Indiana Harbor Works, and U.S. Steel Gary Works**

This memorandum outlines a voluntary agreement to implement a Mercury Pollution Prevention Initiative at Bethlehem Steel Burns Harbor, Ispat Inland Inc. Indiana Harbor Works, and U.S. Steel Gary Works in Northwest Indiana.

### **I. Background**

Bethlehem Steel Burns Harbor, Ispat Inland Inc. Indiana Harbor Works, and U.S. Steel Gary Works, each integrated steel mills operating in Northwest Indiana, are participants in the Lake Michigan Primary Metals Project (the Project). The objective of the Project is to work with members of the primary metals industry in the Lake Michigan basin to identify opportunities for pollution prevention for a range of pollutants that are of concern according to the Lakewide Management Plan for Lake Michigan. In the course of the Project, the companies have been identifying where the Lake Michigan pollutants are found and released in their industrial processes and how they are managed. The companies are also discussing opportunities for reductions of these contaminants and barriers to contaminant reduction.

The Project was initiated by the Lake Michigan Forum, a stakeholders group providing input to the U.S. Environmental Protection Agency (U.S. EPA) and federal and state agencies regarding revisions to the Lake Michigan Lakewide Management Plan. This effort has been coordinated by the Delta Institute, a nonprofit organization, through funding provided by the Joyce Foundation, a private philanthropic foundation headquartered in Chicago, Illinois.

Mercury is a pollutant of concern in Lake Michigan. While mercury releases are generally well below reporting thresholds for the Toxic Release Inventory, mercury is in use at the participating mills, and the mills are interested in responding to the growing concern about mercury in the environment. The mills intend to develop a clean sweep/pollution prevention initiative to inventory, recycle, and substitute to the greatest extent practicable mercury at their facilities.

The Mercury Pollution Prevention Initiative is fully supportive of the goals of the Lakewide

participants as needed.

## **II. Objectives**

The key objectives of the project are as follows:

- Identify mercury uses and quantities within the facility;
- Identify potential mercury pollution sources;
- Identify mercury in the waste stream; and
- Determine mercury pollution prevention options including on-going management of mercury, recycling, and substitutions.

This effort is expected to result in the elimination of mercury use to the extent practicable, consolidation and better management of mercury, replacement of equipment containing mercury, the establishment of purchasing criteria, and development of educational initiatives for facility employees.

## **III. Activities To Be Conducted**

### **A. Kickoff Meeting**

Participating companies will meet with IDEM and U.S. EPA to identify potential sources of mercury that would be examined during the inventory. IDEM and EPA will provide a generic list of typical mercury sources to augment a list of sources particular to integrated steel mills.

### **B. Inventory**

Participating companies will conduct an inventory of:

- 1) Current and on-going purchases of mercury and mercury containing equipment and material;
- 2) Mercury in use at the facilities in equipment and materials, and liquid mercury in storage.
- 3) The presence of mercury in waste streams such as blast furnace sludge, sinter plant pollution control dust or sludge, and coke oven by-product plant wastes.

A summary report of the inventory will be prepared and submitted to the Lake Michigan Forum, IDEM, and U.S. EPA.

### **C. Identify Alternatives**

After the inventory is completed, the participants will identify alternatives to mercury-containing equipment and materials. To identify alternatives, the participants will evaluate

Assistance, and U.S. EPA's Great Lakes National Program Office.

#### **IV. Milestones and Schedule**

The following milestones and schedule are set forth for this initiative.

Milestone

Completion Date

D. Nothing in this agreement prohibits any of the parties from entering into similar agreements with other entities.

E. The participation of the parties in this agreement does not imply or express an endorsement of any policy or position advocated by the other parties nor of any good or service offered by the other parties.

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# Appendix B

## ISPAT INLAND INC. QUALITY MANAGEMENT SYSTEM

Affected Area: **Indiana Harbor Works**

Title: **Mercury Reduction and Waste Management Program**

Procedure No. **ENV-P-020**

### I. PURPOSE

This procedure establishes the responsibilities and practices necessary to implement a mercury reduction/management program in accordance with the provisions of the voluntary mercury reduction and pollution prevention agreement with the U.S. Environmental Protection Agency (USEPA), the Indiana Department of Environmental Management (IDEM) and the Lake Michigan Forum.

### II. SCOPE

This procedure applies to all departments that use, store, or otherwise handle mercury, mercury-containing chemicals, or mercury-containing devices other than those regulated as universal wastes (See Environmental Procedure ENV-P-019).

### III. REFERENCES

- The voluntary "Mercury Pollution Prevention Initiative" agreement with the U.S.EPA, IDEM and the Lake Michigan Forum signed on September 25, 1998.
- Environmental Procedure ENV-P-019, "Universal Waste Management Program"
- Environmental Procedure ENV-P-015, "Cleanup and Disposal of Spilled and Contaminated Material"
- Environmental Procedure ENV-P-016, "Spill Response and Notification Procedure Immediate Actions"
- Environmental Policy ENV-002, "Unauthorized Waste Disposal"
- Environmental Bulletin ENV-B-001, "Release Reporting"
- Departmental Spill Prevention Control and Countermeasure (SPCC) Plans

IV. EXAMPLES OF MERCURY-CONTAINING MATERIALS AND DEVICES

The following are examples of mercury-containing materials and devices that may be found at the Indiana Harbor Works. Not included are the mercury-containing devices (lamps, batteries, and thermostats) that are regulated as universal wastes (See Environmental Procedure ENV-P-019, "Universal Waste Management Program").

- > Elemental (Liquid) Mercury
- > Barometers
- > Hydrometers
- > Manometers
- > Pyrometers
- > Light Switches
- > Tilt (Motion) Switches
- > Various Industrial Switches
- > Laboratory Chemicals and Solutions
- > Thermocouples
- > Thermometers
- > Rectifiers
- > Relays
- > Ignitron Tubes
- > Various Other Gauges and Devices

V. RESPONSIBILITIES

A. Department Heads

1. Contact the By-Product Materials Section of Logistics at extension 3687 for assistance in establishing a comprehensive departmental program for managing mercury-containing wastes to ensure that the department fulfills all applicable requirements of this procedure.
2. Establish departmental procedures and assign responsibility for compiling and maintaining a departmental inventory of known or suspected mercury-containing materials and devices. Contact Environmental Affairs at extension 6296 for guidance and assistance regarding the initial inventorying of mercury-containing materials and devices.
3. Assign responsibility for the proper management of mercury-containing wastes and the development of specific mercury reduction plans through equipment substitutions and purchasing practices.
4. Review the provisions of this procedure with supervisors and outside contractors working under your jurisdiction so that the requirements for managing mercury and mercury containing wastes are understood by all.
  1. Ensure that mercury-containing wastes are properly segregated from nonhazardous, universal and other hazardous wastes, and accumulated in a secure area that is readily accessible to personnel and mobile equipment for emergency response and/or disposal purposes.
  2. Instruct all personnel involved in the handling/management of mercury-containing materials/wastes of the proper procedures emphasizing the consequences of improper management (See Section VI, D of this procedure). Record training in the CESA System.
  3. Departmental personnel shall contact the By-Product Materials Section of Logistics at extension 3687 or Environmental Affairs at extension 6296 if there are any questions regarding the handling/management of mercury-containing wastes not mentioned in this procedure and/or in Environmental Procedure ENV-P-019, "Universal Waste Management Program".
  4. Report unauthorized disposal or attempted disposal on-site of any material that is known or suspected of being toxic or hazardous to By-Product Materials at extension 3687.

## Logistics Department, By-Product Materials Section

1. Provide overall coordination of the waste mercury management and disposition program.
2. Designate properly qualified personnel to direct waste shipment and disposition activities to ensure compliance with this procedure, and assist other departments in matters relating to on-site management.
3. Generate and distribute as required, all Ispat Inland Inc. and regulatory agency mandated waste tracking documents.
4. Ensure that all mercury waste tracking and record keeping requirements are complied with and that any violation of established procedures are reported immediately to the By-Product Materials Section Manager. All required records and documents must be available for inspection upon request by representatives of the U.S. EPA and/or the state.





- **NEVER** use an ordinary vacuum or shop vacuum to clean up mercury. The vacuum will put mercury vapor into the air and increase the likelihood of human exposure. The vacuum cleaner will be contaminated and will have to be disposed of properly with the spilled mercury.
- **NEVER** use a broom or a paint brush to clean up mercury. It will break the mercury into smaller beads and spread them around.
- **NEVER** use industrial/commercial cleaners containing ammonia or chlorine to clean up a mercury spill. They can react violently with mercury, releasing toxic gases.
- **NEVER** place contaminated garments in a washing machine or clothes dryer or combine with other clothing. Instead, place contaminated garments in a plastic bag and seal the bag before ensuring proper disposal.

Unauthorized disposal or attempted disposal on-site of any material or waste that is known or suspected of being toxic or hazardous, shall be reported immediately by operating supervisors to appropriate By-Product Materials personnel, who in turn, will report to the Environmental Affairs Department. Environmental Affairs will initiate an investigation. Upon determination of the facts surrounding violation of this procedure and/or appropriate regulations, the manager of the department involved will be informed of the nature and seriousness of this procedure and site and sent.



### **Switches, Relays and Thermostats— Non-Mercury Substitution Options**

- Steel ball switches
- Nontoxic liquid metal alloys
- Open contact magnetic snap switches
- Sealed magnetic snap switches
- Digital Thermostats
- Hybrid thermostats
- Light sensing heat thermostats
- Hard contact switches
- Photoelectric sensors
- Non-mercury mechanical relays
- Solid state relays

For more information on switches, relays, other industrial devices and their non-mercury alternatives, consult the following web sites.

Description of different relay types:

**[http://www.fda.gov/ora/inspect\\_ref/itg/itg51.html](http://www.fda.gov/ora/inspect_ref/itg/itg51.html)**

Industrial temperature measurement and control, plus a link to the Wilkerson Instrument catalogue:

**<http://www.wici.com/technote/tmcover.htm>**

Temperature and power control technologies and Watlow mercury and non-mercury switches and relays:

**<http://www.watlow.com>**

Comus International mercury and non-mercury switches and relays:

**<http://www.comus-intl.com>**

